# POST-MORTEM EXAMINATIONS

VIRCHOW

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# METHOD OF PERFORMING POST-MORTEM EXAMINATIONS

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# DESCRIPTION AND EXPLANATION OF THE METHOD OF PERFORMING

# POST-MORTEM EXAMINATIONS

IN THE DEAD-HOUSE OF

THE BERLIN CHARITÉ HOSPITAL

WITH

*ESPECIAL REFERENCE TO MEDICO-LEGAL PRACTICE*

BY

PROFESSOR RUDOLPH VIRCHOW

*(From the Charité-Annalen)*

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# TRANSLATOR'S PREFACE.

In the following paper Prof. Virchow gives some account of his early experience as Prosector in the dead-house of the Berlin Charité Hospital, and traces the subsequent development, under his auspices, of a systematic method of conducting post-mortem examinations. He also criticises, explains, and illustrates the regulations which have been promulgated throughout Germany for the guidance of medical jurists in performing autopsies and drawing up reports. (Regulativ für das Verfahren der Gerichtsärzte bei den gerichtlichen Untersuchungen menschlicher Leichname. Herausgegeben von der Königl. wissenschaftlichen Deputation für das Medicinalwesen, 8, 1875.) He also gives three interesting cases in which the post-mortem examinations were performed by himself, the order of sequence enjoined by the regulations being closely adhered to. An examination of these cases will show that nothing has been omitted which could throw any possible light on the cause of death. They may be taken as examples of the way in which all post-mortem examinations for medico-legal purposes should be conducted. Lest the length of the notes should seem excessive, Prof. Virchow expressly states that three hours are sufficient even for complicated cases. It will be obvious, on referring to the details, that only by following out a systematic plan could a thoroughly complete examination be performed in that time. Such an examination, however, would be infinitely more satisfactory than one in which important points were overlooked, and only discovered on subsequent investigation. It is much to be wished that a method similar to the one which has received the high sanction of Prof. Virchow were adopted in this country.

T. P. SMITH.

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### A DESCRIPTION AND EXPLANATION OF THE

# METHOD OF PERFORMING POST-MORTEM EXAMINATIONS.*

On taking up my appointment, in the year 1844, as assistant to Robert Froriep, the Prosector at the Charité, I found that the autopsies were at that time somewhat irregularly and unmethodically performed. The Prosector himself made but few examinations, and these only by special requisition; the greater number were performed, without any technical plan, by the Charité surgeons—young medical men, subsequently styled "assistants," who had not yet passed the State examination. No minutes of the proceedings were made at the time, and only when the examination was over were notes taken down from memory. Froriep himself but very rarely gave a course on post-mortem examinations: he did so only once during my experience. Notwithstanding his eminent scientific attainments and his great manual dexterity (perhaps, indeed, on account of these his qualifications—at any rate, as a consequence of their limited practical employment), there was but little thoroughness in Froriep's method; in many respects, indeed, it was so ill adapted for the purpose, that it was a matter of difficulty to make any discoveries by its means.

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* From the *Charité-Annalen*.

Thus, to take only one example, it was his custom, when examining the spinal cord, to divide it longitudinally, from before or behind, by one long straight cut, and to dissect it in two equal lateral halves. This certainly made a very elegant section, and to do it properly required practice and care; but, however well it was performed, there were but very few cases in which it was of any use. The natural consequence was that Froriep's attention was directed principally to the membranes and roots of the nerves, and that the commonest and most important alterations in the white substance remained unnoticed.

I therefore had a double task to perform, especially after I became Prosector in 1846. On the one hand, I aimed at causing the autopsies to be made by one person, at introducing a system of regular note-taking, and of collecting these notes in order to obtain a useful series of reports. This was a matter of no great difficulty, after many startling incidents had shown how thoroughly erroneous were the results obtained in the absence of technical skill. It very soon happened that every clinical teacher and class-director became interested in the fact that the post-mortem examinations were made by my hand. When, in the year 1849, I accepted the call to Würzburg, I left behind me a large collection of reliable reports. Unfortunately, only a few fragments of these were forthcoming when I was recalled to the Charité in 1856.

On the other hand, it was necessary to discover a regular method for pathologico-anatomical investigation, and to introduce a definite employment of technical terms, which could be adhered to as a rule for all ordinary cases. Such a method I have perfected as years have rolled on, and it has now been sufficiently long in use for its value to have been tested by experience. It has naturally been formed into shape from a double point of view. The first requirement was that it should permit of the most complete insight possible into the extent of the alterations in every organ; and, in the second place, in order to provide for a distinct demonstration adapted for educational purposes, such an arrangement was necessary as would cause the least possible disturbance in the connection of the parts examined. There were therefore these two problems, to some extent opposed to each other. They have nevertheless been solved in a satisfactory manner.

I have at present no intention of discussing this method in all its details. This has been done, to a certain extent, in the recent regulations drawn up, for the guidance of the medical jurist when making autopsies for legal purposes, by the Royal Committee of Science for Medical Affairs, under date of January 6 of this year (1874), and confirmed by the Minister of the Ecclesiastical, Educational, and Medical Departments, under date February 13 of the same year, and to which I may refer.

It is true that these regulations do not correspond in all particulars with our system. This depends, in part, upon the difference in the nature of the tasks—which, for example, is very striking in every step of the external inspection, this latter being far more important for the medical jurist than for the pathological anatomist. Another point is that it has been thought expedient in the deliberations of the Committee to make certain alterations, which permit of a more simple and rapid manipulation of those organs which are less important for legal purposes. Taken as a whole, the regulations are invariably an expression of the knowledge, acquired through long experience, of the most suitable arrangements for conducting post-mortem examinations.

The necessity for superseding the old rules of November 15, 1858, had gradually become very urgent. Strictly speaking, these were already antiquated at the time of their issue. They had no sooner appeared than I pointed out their defects, and drew particular attention to the necessity of insisting—in autopsies for medico-legal purposes, as in everything else now, upon completeness of examination and exactness of method, both in the investigation and in note-taking, so that it might be decided—subsequently, though not in anticipation—whether there was any significance or importance in what was observed, or whether it was accidental and unessential. (*Deutsche Klinik*, 1859, No. 2.) There was, in truth, even at that time, no difference of opinion on these points. The regulations certainly continued in force for fifteen years: this, however, is accounted for not merely by the legitimate bias of the authorities against too frequent changes, but still more so by the recognition of the fact that, before making demands, which, in no trifling degree, exceeded the limits of that amount of technical medical training which had previously been deemed sufficient, it would be necessary first to train a larger number of well-educated medical jurists. This held good not merely with regard to the microscopical examination necessary in so many cases, but even with reference to the ordinary anatomical technicalities of post-mortem examinations.

So long ago as 1859 I indicated in my lectures the direction which the change should take. I then stated as follows:—"The present generation is conversant with pathological anatomy only as a supplement of the clinic. As a rule, the clinical teacher determined while the patient was alive which organ was to be the object of investigation: and the autopsy likewise was usually confined to that organ, or at least dealt with all the others only in a secondary manner. The clinical anamnesis consequently decided the course of the anatomical examination. We all know what was the result. The fact is that we can further the advance of medical science in the most essential manner by acquiring the habit of submitting all the other organs of the body to a minute examination: for it is obvious that we can do as much by anatomical as by clinical examination." I ought, indeed, perhaps to have said that we have to do more by anatomical than by clinical observation, for the one reason that the anatomical examination must be completed once for all, and does not admit of repetition; whereas we can at the bedside, as a rule, return again and again to the same case, and if any omission has occurred in one examination, it can be remedied in the next or a subsequent one. But, irrespective of this, there is a great difference between being able to get directly at an internal organ and examine it in every particular, and having to content ourselves with following out and realising certain symptoms.

Medico-legal technics—with all due deference to the independence of forensic medicine—will, however, always go hand-in-hand with pathological anatomy; for this latter is the more universal: it has to deal with cases of all kinds, and for that reason is a great protection against that one-sidedness with which medico-legal practice is so much encumbered. As a matter of fact, it must be conceded that the great majority of medico-legal reports have exhibited such an astonishing sameness, even in their phraseology; such a very peculiar style, nowhere else to be found; such a want of real objectivity, that it was an extremely tedious business to read through any number of them consecutively. There was such an amount of similarity among many of them that it might have been thought that they all referred to the same case.

The number of better educated physicians has gradually increased. The new examination for the North German Bund, and more recently for the German Empire, recognises pathological anatomy as a special subject, and also tests the candidates in pathological histology. A more intimate knowledge of pathologico-anatomical technics and microscopical manipulation has been thereby introduced; and it was therefore high time, considering that the examination rules of September 25, 1869, had now been six years in force, to lay down similar directions for the forensic examination, and afterwards to institute regulations for conducting autopsies for medico-legal purposes. This has now been done, and it is to be hoped that the innovation will prove very beneficial, and promote the efficacy of the laws; for a not insignificant portion of the administration of the criminal law is entirely dependent upon a correct and objective examination on the part of the medical jurist.

Experience, indeed, teaches us that the great majority of cases in which the Courts are compelled to appeal for advice to the Medical Colleges and to the Committee of Science for Medical Affairs, refer to those autopsies in which either the examination or the note-taking has been so irregularly performed that the nature of the case still remains ambiguous. It would, I am sure, be a matter of no difficulty to collect a great number of examples in which the faulty performance of the autopsy has rendered obscure cases in themselves clear and simple, and has made unintelligible those which were at all ambiguous. This observation explains the increasing number of the revision remarks, which are so complained of by many physicians, and also the necessity for inserting many detailed directions—perfectly obvious,but not always attended to—in the regulations for the due performance of autopsies. The revision remarks having been brought to the cognisance of the State Attorney and the Court, the prosecution of an accused person can be resumed; this, for a long time, had not been possible, owing to faulty examinations and the very arbitrary opinions expressed by those who performed them.

After such experiences, which, considering the evidence obtained in the medical examinations with reference to the ordinary way in which cases are investigated and observed, may easily extend in various other directions, the practical necessity of laying down strict rules appeared quite imperative. In like manner, there could be no doubt that, for educational purposes, and for the majority of ordinary cases, a methodical procedure in post-mortem examinations presupposes the establishment of a definite plan.

It is scarcely necessary to point out that there are many cases in which deviations from this method are not merely allowable, but also absolutely necessary. The individuality of the case must often determine the plan of the examination. But we must not begin with individualising, nor make a rule of the exceptions. The expert may allow himself to make alterations, supposing they are well grounded, but he must be able to remember his motive for so doing, and also to state it.

For this purpose, however, a full and intimate acquaintance with the reasons why the plan or rule has been laid down is quite imperative. The method should be practised, not mechanically, but systematically, as it has for its basis well-weighed experience, and not mere casual observations. He who is conversant with these reasons will also be able to judge of their correctness, and of the occasions when a departure from the rule is indicated. Thus the rule will be that when the cranial cavity is opened, the exposed parts—viz., the dura mater, the great longitudinal sinus, the pia mater, the surface of the cerebral hemispheres—must be first examined, and described in succession. But if the dura mater is adherent to the skull-cap, the best plan is to divide the former before forcibly detaching the latter, and to remove the skull-cap with the dura mater adhering to it; for if long and violent attempts be made to separate the skull-cap from the still closed and adherent dura mater, this latter usually gets torn, the brain itself crushed, and the parts so altered that sometimes their original condition is quite undiscoverable. In new-born infants and in children these parts are, as a rule, adherent; so that in these young subjects, if we wish to avoid the risk of converting the brain into a mass of pulp, we must make an alteration in the method adapted for examining adult cases. But if these adhesions are found in adults as individual appearances in exceptional cases, we must also in such cases make an alteration in the method to be pursued.

In a systematic and scientific performance of an autopsy nothing is more difficult, and at the same time more important, than the insight into the reasons for pursuing a definite order of sequence in every detail of the examination. Let us therefore consider this point somewhat minutely. The course of the examination is generally dependent upon the order of succession. If for ordinary cases we require a definite process and a prescribed order, we do so not merely because such an arrangement is the surest guarantee for the completeness of the examination, and the best preventive against omitting important parts, but for the still greater reason that an unmethodical plan is the greatest possible obstacle to the subsequent collection of valuable reports. An unmethodical examination artificially and prematurely obliterates the existent condition of the parts.

Let us take a few examples. In many examinations the position of the diaphragm is of the greatest importance. This, generally speaking, cannot be determined if we open the thorax before the abdomen, or even at the same time; or if, after first opening the abdomen, we do not examine the diaphragm before opening the thorax. In former times, when the physicians allowed the assistants to make the post-mortem examinations, the custom was almost universal for a dissecting-room servant to open the thorax and abdomen before the arrival of the medical staff. The object was to save time and trouble. It soon became evident in forensic practice that such a proceeding as this made it impossible to define exactly the state of the thorax and its contents. In new-born children especially, it is necessary to ascertain carefully the position of the diaphragm, because in them the main question hinges upon the establishment of respiration; and not merely this, but the extent to which respiration has been carried is the important point. On this account the direction was that the abdomen should be opened first. The regulation of 1858 was in this respect quite correct. Section 17, *a*, ran as follows:—"After the abdomen has been opened, the position of the diaphragm is to be noted with reference to the corresponding ribs; and to ascertain this correctly in new-born children the abdomen should be opened first, and subsequently the thorax and head." Unfortunately, this very proper direction was made obscure by the words immediately preceding it. They ran thus:—"The respiration test must now be commenced, and for this purpose, (*a*) after the abdomen has been opened," etc. This preface was altogether out of place, for we do not determine the position of the diaphragm with a view to the respiration test, but both are co-ordinate means for establishing the fact that respiration has been performed. Still worse, however, was the ambiguity involved in the choice of the expression "opening." Taken by itself the word is not synonymous with "dissection," but the medical jurists made use of "opening" in the sense of "dissection," and instead of opening and dissecting the thorax immediately after opening the abdomen and determining the position of the diaphragm, they finished the dissection of the abdomen before they even opened the thorax. Indeed, this bad practice was so universal, that even when, as occasionally happened, a more enlightened physician examined the thorax first, and then dissected the abdomen, he was blamed for so doing by the medical boards in their revision reports.

What, however, is the consequence of thus first dissecting the abdomen? I will assume that in the removal of the spleen, the stomach, and the liver, the diaphragm has not been cut, although this indeed frequently happens; but on cutting through the veins of the liver (in removing this organ), and on opening, as particularly directed, the inferior vena cava, it is impossible to prevent the blood escaping partially or, if not coagulated, completely from the right auricle through the large venous trunks which have been opened. If, after this has been done, the thorax be examined, it is quite possible that the right auricle and the right side of the heart may be found collapsed and containing little or no blood, in cases where proper examination would have revealed an entirely opposite state of things. How often it happens that the report is, in consequence, very different from what it ought to be, and the opinion based thereon also falsified!

For this reason the new regulation directs, what I have for years taught, that, under all circumstances, the abdomen is to be first opened, but not dissected. It is only necessary in this stage to determine the position of the diaphragm, as well as that of the organs, any abnormal contents of the abdomen which may possibly be present, and the colour of the parts exposed. Then the thorax is immediately to be examined, unless there is some cogent reason for departing from the rule. The suspicion of poisoning is always admitted to be a reason of this nature, as in this case the whole of the examination centres in the stomach; and every precaution must be taken to place it and its contents, without loss or change, at the disposal of the law.

The regulation that, as a rule, the dissection of the abdomen is to follow that of the thorax, but, on the other hand, that the abdomen is to be opened, and its general state determined before the opening of the thorax, has necessitated, in the new regulations, the altering of certain directions referring to the minutes of examinations. It is to be hoped that medical jurists will readily familiarise themselves with these changes, and it is not necessary further to allude to them. On the other hand, it appears to me that it is not superfluous to explain why it is that we ought to determine the general condition of the abdominal organs before opening the thorax. In reference to this, the new regulations order as follows, in section 18, line 2:—"In addition to this, the position, colour, and other appearances presented by the exposed intestines, and also the occurrence of any abnormal contents, are next to be specified, and the position of the diaphragm to be determined by examining it with the hand."

It is evident that the position of the abdominal viscera cannot be exactly determined after the thorax has been opened and the anterior attachments of the diaphragm to a great extent divided. The further the examination of the thorax proceeds, the more numerous the organs which are removed, and the more freely the connections between the diaphragm and parts of the thorax are divided, the looser does this muscle become, and the greater the displacement of the abdominal viscera towards the thoracic cavity. A further examination may reveal something previously unnoticed, and necessitating a comparison between the position of the abdominal viscera and injuries of the abdominal walls, and we may wish to examine thoroughly the relations to each other of two of the abdominal viscera; but the previous opening of the thorax will render all such attempts nugatory. I need only mention those by no means rare cases in which incipient peritonitis is discovered, and where it becomes necessary to ascertain whether the peritonitis was caused by injury or was due to a pathological process in any one of the abdominal viscera. In a case where the spot which exhibits the signs of a limited peritonitis is not exposed when the abdomen is opened, it will scarcely be possible to determine the causal connection if the position of the viscera has been much disturbed before the spot has been discovered.

With regard to the *colour* of the abdominal viscera, we must especially bear in mind that the notion is even now very prevalent that arterial blood, and therefore the arterial vessels, in the dead body as in the living, are distinguishable by their deep-red (*hochroth*) or bright-red (*hellroth*) colour. This notion is founded on a primary error. Arterial blood in a dead body is always of a dusky-red colour. This is just as true with regard to the blood of the pulmonary veins and left side of the heart as to that of the aorta and peripheral arteries. Any one who has carefully noticed the large arteries on the base of the brain, which, on account of their relatively free and superficial course, are very convenient for observation; any one who has been impressed with their bluish-red, thoroughly venous appearance; any one who has carefully observed in the left auricle the dusky-red blood which has just come from the lungs and just been aërated, and this in persons who have not died from suffocation,—ought for ever to be cured of the mistake of supposing that a dead body contains bright-red arterial blood. No recently exposed portion of a dead body has a bright-red colour; the lung certainly may form an exception to this statement, but only when filled with air, in which case, even after death, a certain quantity of oxygen may be absorbed. And even in the lung this is not usually the case to the extent supposed. In this organ the tissue containing the blood is full of alveoli containing air, and thus, as when froth is formed, a whitish colour is produced, which, mixed with dusky-red, produces a bright-red shade. This is beautifully seen in the lungs of new-born children.

It follows, as a matter of course, and in individual cases it can be directly proved, that in no portion of the viscera of a dead body can arterial injection be recognised by the colour test. Even when the arterial injection is very considerable, the colour of the part may be just as bluish-red or blackish-red as in venous hyperæmia. Whoever wishes to assure himself on this point may do so by examining the kidneys, where, with the naked eye or with a simple lens, he will easily see the Malpighian corpuscles, purely arterial structures, appearing as very dark-red points or granules in consequence of the fulness of their vessels.

After death, however, the blood does not lose its power of absorbing oxygen, and of thereby assuming an arterial appearance—*i.e.*, a deep-red colour. This statement, indeed, must be taken with certain limitations, for there are some cases in which the blood, even before death, possesses a much diminished power of absorbing oxygen, and there are others in which it becomes so altered after death that its capacity in this respect is entirely lost. In both cases it is, however, arterial blood. On the other hand, even in ordinary cases, venous blood in the dead body possesses the power of absorbing oxygen. Thus it may happen that a part affected with venous hyperaemia becomes, when exposed to the air, after a time, deep-red in colour, and exhibits the appearance of an arterial injection. Naturally the change takes place much less readily and quickly in large and very full veins than in small ones; it is therefore of most frequent occurrence in the plexuses formed by the venous radicles.

What a great number of erroneous judgments have been due to want of knowledge of these very simple facts! How often has irritation or even inflammation been inferred merely because of a deep-red colour of the parts, or of a deep-red injection of the small vessels, whereas this coloration has really arisen in the course of the dissection! For the time usually required for the examination of the thoracic organs is amply sufficient for the change, from dark-red to bright-red, to take place in those viscera of the abdomen which have been exposed. Hence the requirement in the regulations that the colour of the exposed portions of the abdomen is to be determined directly the cavity has been opened—that is, before the oxygen of the air that has gained access has had time to exert its influence.

As I have just touched upon this subject, I may say a few words more with reference to the much misused term, "fulness of the vessels." With regard to this, it appears to me important, considering the only too frequent incidents impressed on my memory, to lay great stress on the following points:—

1. Capillary injection cannot be recognised as such, in a general way, with the naked eye. The finest vascular network which the naked eye is able to discriminate is either arterial or venous, and in the majority of cases, venous. This holds good especially of mucous membranes, in which the comparatively superficial position of the venous radicles very frequently causes them to be mistaken for capillaries. All capillaries are microscopic objects, and when filled with blood it is not red capillaries but red tissue which is

observable. This redness really gleams out from the interior of the tissue, and we can here, in a certain sense, justly say that the tissue is injected. Nowhere can this condition be so well observed as in the cerebral substance, especially in the soft, translucent grey matter. All shades, from the faintest reddish tinge up to a dark hydrangea-red, are here met with, and though single fine vessels filled with blood may be distinguished in the red spots, we can easily demonstrate that the colour of the tissue is not due to these vessels. To this category belongs that peculiar mottled redness which is not unfrequently found in the white medullary substance and in the optic thalamus and corpus striatum, and which is very similar to the first symptom of frost-redness on the surface of the body. In my "Cellular Pathology" (fourth edition, page 107, Fig. 35) I have given an illustration of such a condition; it can easily be understood from this; only the few larger vessels, which are shown in the drawing, could with difficulty be made out with a lens; all the other vessels were only visible on careful examination with the microscope. It is, therefore, intelligible that to an expert there is something absurd in the expression "inflammatory hyperæmia" (occurring as it does in numerous reports) referring to anything which can be directly discovered with the naked eye. Nowhere is this expression more absurd than when it is used in reference to the stomach, as it can be proved in the majority of the reports that what the observer has noticed have only been veins.

2. The venous or arterial character of a vessel is never to be determined by the quality of the blood therein contained; but in all cases we must be guided only by its structure, its connections, and its position. In other words, it is not to be discovered at the autopsy whether a vessel is an artery or a vein; but, with regard at least to all larger vessels, this ought to be known previously. It is true, that it once occurred to me that a practising phy-

sician, who presented himself for examination, was very much astonished when (in consequence of various wrong answers) I asked him a question as to the nature of some of the larger vessels of the brain. His answer was, that he had not prepared himself on that subject, because he had not expected to be asked any questions, in this examination, in normal anatomy. However, I think I can maintain the proposition, that, inasmuch as without a correct knowledge of angiology, and even of the smaller vessels, the results of a medico-legal investigation may so easily be false, no one can possibly be a good medical jurist who is is not thoroughly conversant with these matters. In referring especially to medical jurists, I do not, of course, mean to imply that such knowledge ought not to be possessed by ordinary physicians; but what I wish to express is, that it is still more obligatory in the former class. In puzzling cases (which, I admit, do occur to the expert, and even to the anatomist) there is one plan which will be found to be of the greatest assistance, and that is to follow the course of the vessel until a point is reached where the size becomes a sufficient guide as to its nature, even to the less experienced observers; and particularly if in a membrane we meet with a smaller vessel filled with blood, we can, by displacing the blood, often succeed in ascertaining the course and connection of the vessel.

3. A statement with reference to the quantity of blood contained in a part can only be regarded as approximatively exact when the description indicates not only the kind of vessels in which the blood is contained, but also, to some extent, the degree of their fulness. By this I do not assert that we are able without minute examination—which is not in all cases possible—to make such statements with regard to all parts; and with reference to many of them, I confess that a general description of their appearance and colour is all that is required. This holds good, for example, of the spleen, with regard to which no one,

by simply looking at the surface of a section, could properly estimate which of the small vessels were filled, and the extent of their fulness. But there are many parts of the body—and this refers especially to the mucous and serous membranes; consequently, to the majority of the internal surfaces—which can very easily be examined, and in which, in important cases, the attempt should always be made to ascertain positively the nature of the vessels concerned. It is certainly easier to pronounce an opinion than to give such a description; but the experience of the slight utility of such opinions has caused the Committee of Sciences to include the following direction in their new Regulations, section 28.

"In all cases a statement must be given with reference to the amount of blood contained in each important part: and what is required is not merely an opinion, but a terse description, using such terms as 'profuse,' 'moderate,' 'slight,' 'much reddened,' 'full of blood,' 'bloodless,' etc."

This explanation may suffice to illustrate the way in which statements should be made with reference to the colour of the exposed abdominal viscera, and to what extent it is important that this should be determined immediately after the abdomen is opened. I will only make one more remark—that every manipulation of the intestines and other parts of the abdomen, by which their position is altered, their mutual pressure diminished or increased, or even any direct pressure with the hand, alters the amount of blood contained, and not only of this, but also of the gaseous, fluid, or more solid matter contained in separate portions of the intestines.

Still more important than the determination of the colour is the immediate ascertaining of any foreign substance which the abdomen may happen to contain. If there be gas, it is very obvious that its existence can be generally proved only at the moment of opening the abdomen. If it be a liquid, there is the danger of losing some of it unless it be collected at once. In every case, however, when the thorax is opened and its contents removed, it is almost impossible to prevent blood and other fluids from getting into the abdomen; and thus, when this latter cavity is examined, the appearances are obscured or directly falsified. The like holds good of those cases in which the subsequent examination has particularly to be directed not to the thorax, but to single parts of the abdomen: for example, the stomach. It is extremely difficult, in removing and opening this organ, to avoid soiling the abdomen; and therefore, if the existence or non-existence of any anomalous contents has not been previously determined, it is scarcely possible to do this after the stomach has been interfered with.

I can be much more brief in my remarks with regard to the first portion of the examination of the thorax. Nevertheless, clear as the conditions are, I know from manifold experience how difficult it is to arrange a definite method of procedure. In explanation, I must first make the apparently paradoxical remark that "thorax," strictly speaking, is quite an abstract term. In reality, there is nothing which corresponds to it except in the skeleton, or in a cadaver from which the viscera have been removed. In the living subject and in the ordinary condition of a dead body there is not one, but several, thoracic cavities. For there are, in the first place, two quite separate pleural sacs, and therefore also pleural cavities; and, in the next place, a pericardium, and in it a pericardial cavity.

Therefore in a dead body we never really open the "thoracic cavity," but rather, if in removing the breastbone we do not somewhat awkwardly cut and "open" the pericardium as well, the result is that when the sternum, together with the cartilages of the ribs, has been detached, we come on each side into a pleural cavity or space. The so-called mediastinum is no cavity in this sense, but a septum filled with loose tissue, and it would be far more intelligible if we represented the mediastinum as a septum, and did not speak of it as a space. As, therefore, in opening the thoracic cavity we really come into the pleural sacs, our duty is here, as in the abdomen, immediately to examine both these sacs with regard to the position, colour, etc., of their contents, and also to look very particularly for any possible foreign body which may be present. This examination is much more important here than in the abdomen, for it happens only too often that in cutting through the first rib and the sterno-clavicular articulation, as well as in the actual removal of the sternum, large veins (such as the internal mammary, the internal jugular, and the innominate) are pierced, cut, or torn, and fluid or coagulated blood escapes. In a short time this finds its way into one or even both of the pleural sacs, and, no matter whether these previously contained anything or not, it is subsequently impossible to express a positive opinion, either as regards the quantity or the quality, or in many cases even to decide as to the pre-existence, of any contents whatever. I need not explain how very important the demonstration of any anomalous contents in one or both pleural sacs may be in helping us to form an opinion with regard to a case, and I therefore think that it is certainly proper always to commence the examination of the thoracic cavity by ascertaining the condition of the pleural sacs, and to leave the lungs and the pericardium for subsequent observation. For he who would open the pericardium and dissect the heart before determining whether haematothorax or hydrothorax or pleuritis be present, is a man who ought not to undertake a post-mortem examination at all.

But it is just as evident that the lungs ought not to be removed from the thorax before the heart has been examined, for this cannot be done without separating the pulmonary artery and veins. Unless ligatures are previously applied to these vessels—and it is neither customary nor needful so to do—their division will be immediately followed by the escape of a certain amount of the contents of the left auricle, of the trunk of the pulmonary artery, and of the right ventricle; and just the same thing happens as when we remove the liver and open the inferior vena cava before opening the thorax—viz., a diminution in the quantity of blood contained, or else a complete emptying of important parts of the heart.

Reflections such as these, very naturally and for certainly sufficient reasons, lead to the formation of a definite plan of examination of the parts, which is in no way dependent upon personal caprice or considerations of convenience, but follows necessarily from the nature of the thing itself.

I do not here intend to offer any exhaustive exposition of the reasons why I adopt precisely that order of sequence of which the Regulations are the authoritative expression. I may venture to give, however, a few more explanations with regard to the order of sequence which is directed to be observed in examining the organs of the abdomen.

*a.* For cleanliness' sake I examine the intestines last. To deal with the contents of the intestines is, in itself, a very disagreeable matter. Even with the greatest care, one can scarcely avoid soiling one's self, the instruments and receptacles, the subject, and the table on which it lies. I will say nothing about the sense of smell, though it is a great puzzle to me how it is that some persons, when making autopsies, seem to have completely lost this sense. There is no possible disadvantage in examining, as a rule, the intestines last; for all the other parts can be conveniently examined, removed, and dealt with without the intestines being interfered with. If, however, any one attaches less importance to cleanliness,—if perhaps the physician is in a great hurry, and wishes especially to see the intestines examined,—there is no technical reason why this should not be done before meddling with the other viscera, for the intestines also can be removed without injuring the other parts. There is an exception in the case of the duodenum, inasmuch as the excretory ducts of the liver and pancreas open into it, and its removal is impossible without cutting through these ducts and even a portion of the pancreas.

*b.* The order of sequence which I adopt differs in one main point from that which was previously and formerly almost universally employed, inasmuch as I usually make the removal of the liver the last part but one of the examination. I am well aware that in so doing I depart essentially from the favourite custom. If the dissector places himself, as he usually does, on the right side of the body, having the head to his left, the liver is so immediately in front of his hand that it undoubtedly requires a sort of resignation to make up one's mind to leave it alone. But, irrespective of what I have already enlarged upon (that in the removal of the liver the large veins are injured, and, for the most part, the diaphragm as well), there is also this to be considered: that the hepato-duodenal ligament (the small omentum), and the tubes therein contained, especially the vena portæ and gall-duct, are injured more considerably and to greater disadvantage. I confess that these two last-mentioned structures are, in the great majority of cases, of no importance to the medical jurist, and if the order of sequence necessary for a clinical case were to be enjoined on him, it might certainly appear superfluous. On the other hand, however, it will be no disadvantage to him, and it will involve neither more time nor more trouble, whether he examines the liver first, or last but one: and even granting that the cases are but few in which the more correct method is requisite for the medico-legal investigation, this is quite a sufficient ground for requiring it to be universally adopted. For clinical investigation, the preservation of the hepato-duodenal ligament is of the greatest importance, because, if once divided, it is a mere chance if we succeed in replacing the parts in their natural position in such a way as to be able positively to elucidate their condition. It is here, however, that we have to look for thrombosis and obliterations of the vena portæ, and to estimate the condition, as regards perviousness, of the ductus communis choledochus, particularly of its intestinal portion, and also of the cystic and hepatic ducts. I may refer to a former paper of mine on these subjects. In my *Archives*, 1865, vol. xxxii. page 117, I have discussed the various conditions of the ductus communis choledochus and its intestinal portion, and have alluded to the importance of these for explaining the origination of jaundice; and in the *Transactions of the Würzburg Physico-Medical Society*, 1857, vol. vii. page 21, and in my "Gesammelten Abhandlungen," page 620, I have treated of obstructions of the vena portae. The nature of the circumstances necessitates the following order of sequence in examining these parts. First we should open the duodenum, taking care to do so *in situ*: then determine its contents above and below the papilla biliaria: then this papilla should be examined and its contents gently pressed out; then, by pressing on the gall-bladder, we should determine the presence or absence of obstacles to the flow of bile; and, lastly, the ductus communis choledochus should be slit up. Then the vena cava should be examined; and, all this having been done, the liver should be removed. It is quite useless to pass a probe along the gall-duct, for our being able to introduce a probe into the orifice is no evidence whatever that the portio intestinalis was pervious during life.

*e*. The examination and opening of the stomach are closely connected with the above-mentioned operations. The simplest plan is to open the stomach at the same time as the duodenum, by continuing the incision; and this should, as a rule, be done *in situ*. Cases of poisoning, especially those which come under legal investigation, may require a different course. In other cases there is no danger in allowing the stomach to remain untouched until its turn comes. The spleen, the only organ closely connected with it, may, with moderate care, be so easily separated that there is no fear of causing damage. On the other hand, as is easily intelligible, the examination of the pancreas will follow that of the stomach and duodenum. The slight importance of this organ, in a pathologico-anatomical point of view, causes its examination to be of little consequence.

*d.* All the urinary organs should, as a matter of course, be examined one after the other. We take them, therefore, in this sequence — the kidneys, the ureters, the urinary bladder, and the urethra. At all events, their condition will in this way be much more attentively examined than if some other object of an entirely different nature be allowed to intrude itself while the examination is going on. It is also perfectly evident that the supra-renal capsules and the generative organs must be examined in connection with the urinary organs. They are immediately connected, inasmuch as portions of the generative organs are portions also of the urinary organs, so that for the sake of continuity of plan, and also for convenience in the removal of the parts, the examination of the generative and of the urinary organs should be performed at one and the same time.

The order, therefore, which I adopt in examining the abdominal organs is as follows:

1. The omentum.

2. The spleen.

3. The left kidney, supra-renal capsule, and ureter.

4. The right kidney, supra-renal capsule, and ureter.

5. The bladder, prostate gland, vesiculæ seminales, urethra.

6. (*a*) Testicles, spermatic cord, and penis.

(*b*) Vagina, uterus, Fallopian tubes, ovaries, parametria.

7. The rectum.

8. The duodenum, portio intestinalis of the ductus communis choledochus.

9. Stomach.

10. Hepato-duodenal ligament, gall-ducts, vena portæ, gall-bladder, liver.

11. Pancreas, cœliac (semilunar) ganglia.

12. Mesentery, with its glands, vessels, etc.

13. Small and large intestine.

14. Retro-peritoneal lymphatic glands, receptaculum chyli, aorta, vena cava inferior.

However useful and convenient it may be to keep to such a regular plan, it is impracticable in a small number of cases, in which considerable changes have taken place in the relations and connections of the parts. Chronic adhesive peritonitis, whether occurring *per se*, in a simple, tuberculous, cancerous, or other form, or connected with tumours (*e.g.* ovarian), or with aneurism of the abdominal aorta, usually makes it impossible to dispense with the considerations peculiar to the case, and to adopt any general rule. Even in such cases it will be advisable to complete in the usual way the examination of those organs, which can be easily reached, and thus to lessen gradually the special alterations which are requisite. But a departure from the rule is finally requisite, because it is, generally speaking, most convenient to remove together the remainder of the organs, and to examine them more particularly outside the body, in whatever way is the easiest.

So much with regard to the order of sequence in which the organs are to be examined, and the method of dissection.

The answer to the question, how to make incisions, belongs to quite another side of the subject. What I have to say in reference to this, is the primary result of simple experience, acquired by frequent practice and constant endeavours directed towards simplifying the operative portion of our task. But also, in addition to this, I endeavoured to account to myself for the reasons for my usual *modus operandi.* Thus became developed a systematic practice of the proper method of making incisions. The description, which I shall now give, is based upon grounds which were originally purely empirical, and which have only gradually become modified by additional theoretical considerations. In the first place, I assert emphatically that there must be an essential difference between the method of making incisions for pathological purposes and that which is adapted for the anatomical theatre or dissecting-room. In the ordinary way of making preparations, the young student is taught to hold his knife as he would a pen. The object is to make short fine cuts in order to expose muscles, nerves, and vessels, and to follow them out and show them clearly. Holding the knife in this way, the young student keeps his fingers in the position which became habitual to him, up to a certain point, when he was taught to write. The movements are confined almost entirely to the joints of the fingers—at any rate, to those of the hand. The arm itself is fixed generally in such a way that the elbow-joint is brought close to the trunk, and often to the thorax, unless, indeed, it rests on the crest of the ilium. In this way, short quick cuts may be made with great steadiness, the result of which is that neatness of appearance in a preparation which is appreciated in a moment by the sharp glance of the anatomical teacher. If such fine work be required for pathological anatomy—and this is the case pretty often,—not only is there no objection to this method, but it is absolutely requisite.

This, however, must not be considered to be the rule. An autopsy in which short incisions only are employed, is an unduly tedious affair, and both the pathological anatomist and the medical jurist have far less time at their disposal than is the case with the descriptive anatomist. On the other hand, numerous short incisions cause the larger organs to be too much divided, and partial cuts in no way assist the inspection, and appear to be adapted rather for kitchen purposes than for those of science. In examinations for pathological purposes, we save time and gain increased insight and clearness by making free incisions, and, when possible, such as involve the whole of the organ to be examined.

When this had become evident, I very soon perceived the necessity for holding the knife in a different manner. For all ordinary purposes of pathological dissection I now grasp the handle of the knife in the palm of my hand, so that when I stretch out my arm the blade appears as a direct prolongation. I fix then, relatively, if not absolutely, the joints of the fingers and hand, and make the cutting movements with the entire arm, so that the principal movements occur in the shoulder-joint, the secondary ones in the elbow-joint. In this way I am able to make long and useful incisions, and smooth ones as well, for I can utilise the whole force of the arm, and especially of the muscles about the shoulder; and it is only on surfaces produced by such incisions as these that we are able to see anything really satisfactorily.

After I had got so far, I then perceived that in many roundabout ways I had reached the point which our predecessors in dissection, the butchers, had so long ago attained. I was not a little astonished when one day, not very long ago, I went into a slaughter-house and watched the men at their work. I then learned something else, which I have since brought into practice—viz., that the knife should be wider and longer than that commonly used.

A knife of such length and breadth, so well adapted for the butcher's purpose, is certainly inadmissible for ours, and it is only for the brain, and even then only in particularly important cases, that we require a very large flat-bladed knife which exceeds the dimensions even of those used in the slaughter-house. But a knife for making sections should always be very considerably larger than the ordinary knife used in making preparations. The latter is too short, both in the handle and in the blade, for making really large cuts. On the other hand, the blade is still too large for ordinary preparation purposes; for when held as a pen the point only of the knife is used—a portion measuring scarcely fifteen millimetres. The rest of the blade is so superfluous that the beginner in pathological technics, who comes to me to learn the art of dissecting, immediately takes the knife (which I place in his *hand*) between his *fingers*, and then moves them in a wriggling way forwards on the handle, until their points touch the steel of the blade. It is then naturally impossible to use the whole of the edge, for a large part of it is covered by the hand. As the dissector now finds himself confined to the point of his knife, and can use no other part of it, it is easy to understand that he very soon blunts it, and whereas a good pathological anatomist is perfectly able to dissect all the viscera of one subject, or even of two, with one knife, a pathological "layman," holding his knife as he would a pen, requires three or four knives for one autopsy.

The modified section-knife (*Secirmesser*) which I have introduced differs from the ordinary dissecting-knife (*Präparirmesser*) both in the blade and handle. Both these latter are not only longer, but stronger—that is, thicker and broader. The anterior part of the blade does not form an acute angle, but is rounded off: the very broad surface terminates with a considerable curve in the slightly projecting point. Thus, not only is the cutting edge still further lengthened, but, at the same time, the risk of pricking one's self or others, or of getting a prick from others, during the examination is considerably diminished. The number of dangerous wounds (and pricks are always more dangerous than cuts) has been very much diminished among us since we have adopted this useful kind of knife. As regards the back part of the knife, the blade is narrow and strong near its insertion, for this portion of it is generally not much used; the handle is flatter posteriorly, and much curved inwards from both edges, so that it may lie more conveniently in the hand. Such a knife is, in its original condition, before it has been ground down, twenty-three to twenty-four centimetres long, of which nine centimetres and a half belong to the blade.

This knife should really be used for making incisions with a traction movement. It should not be pressed or pushed into the parts, but should be drawn through them with comparative rapidity. When necessary, we may employ the whole force of the muscles of the shoulder in this movement, and much power can be thus exerted. But the greater the force employed, the quicker must be the movement, or else the parts are liable to become crushed. Nowhere can this be better proved than in the brain. Even a very sharp knife pressed into the brain crushes the parts to a certain extent, and the resulting cut surface is, at least in some measure, useless for examination; often, indeed, the appearance it presents leads directly to false conclusions.

An incision made by traction differs from one made by pressure primarily in this: that in the former every point of the edge glides over or through a certain spot in the organ; whereas in the latter the same point in the edge always presses upon the same spot of the organ. Whoever chooses to make incisions by pressure always, possibly involuntarily, places his forefinger on the back of the knife. He who makes incisions by traction places his forefinger on the surface of the handle, or he grasps the whole handle. At all events, it is a good practice, especially for beginners, to place the handle between the thumb and finger only, so that great pressure is impossible.

Where it is necessary really to exercise great pressure, we require another kind of knife—namely, one with a broader back, to which the forefinger or even the thumb may be conveniently applied. I have for this purpose made a further improvement on the ordinary cartilage-knife: the one which I use has a thicker and more bulging blade, and a much stronger handle. This latter is formed of two strong plates of wood or horn, one of these being applied to each side of a flat prolongation of the blade, reaching the entire length of the handle. The back of such a knife, sixteen millimetres broad, is a convenient support when pressure is required. The free end also of the handle is flattened and broad, so that for certain purposes, such as for separating the sterno-clavicular joint, it can be placed vertically in the palm of the hand, and can be conveniently used for making punctures.

I therefore require for each examination three different knives—an ordinary dissecting-knife (*Präparirmesser*), a peculiar section-knife (*Secirmesser*), and a very strong cartilage-knife. I use the last for all the coarser sort of work—not merely for dividing cartilages, but also for large incisions through skin, muscle, and joints. The section-knife (*Secirmesser*) serves especially for dissecting the large viscera; the dissecting-knife (*Präparirmesser*) for the finer parts, vessels, nerves, etc. But inasmuch as the examination of the large viscera is the primary object of a pathological dissection, it is evident that the section-knife in its present modified form is the principal instrument. In order to use it, the right arm must be allowed to be quite free. The elbow must be raised quite away from the trunk, so that the flexed forearm may be moved freely, and in any direction backwards or forwards. It is, then, easily practicable to divide the integuments of the trunk by one single long incision from the chin to the symphysis pubis. So, also, one incision is sufficient to display the lung from apex to base in two halves. Perhaps this "dodge" (*Schwabenstreich*)—I use the word in the sense of the worthy Frederick Barbarossa—may appear to some improper and culpable. But I candidly own that I am a fanatical admirer of a large incision. The freer the incision—always supposing that it is an even one—the larger will be the field of view, the more numerous will be the points of comparison between normal and abnormal parts, and the more exactly shall we be able to estimate the extent of the pathological territories.

I maintain, indeed, that a free incision, even when wrongly done, is, as a rule, to be preferred to a small, though accurate, one, and is almost always better than several or many small cuts. The large even cut is peculiarly the one for demonstration purposes. To make it, I look carefully at each separate organ, to find where I can get the largest surface on section. I therefore cut through a spleen from above downwards, over the middle of its outer (convex) surface, a kidney from without and within (from the external to the internal border), a liver from right to left in a horizontal direction; the testicle I cut into two nearly equal parts in a perpendicular direction from its free to its attached border, and snap the parts asunder. I divide each lobe of the lung by a perpendicular incision directed from above downwards, and from its thick border towards its inner (anterior, medial, sharp) one. Each hemisphere of the brain I divide by an incision beginning internally just over the corpus striatum, and directed somewhat obliquely outwards. Each hemisphere of the cerebellum I divide by an incision which commences in the fourth ventricle, in the direction of the crus cerebelli, and is carried obliquely outwards.

For many cases, and for several organs, one such cut is sufficient in order to show all that is essential. It very often happens that alterations in the liver, spleen, and kidneys are diffused so uniformly throughout the entire organ that one single cut affords us a sufficient insight into the internal structure of the parts. It is true that in other cases and in other organs—for example, always in the brain—we have to make a larger number of cuts in order to be sure that nothing has been overlooked. Indeed, in the case of the brain we can, properly speaking, never positively assert that it is quite normal, unless we divide it into quite microscopic portions according to the new method of Herr von Gudden. But as this is only practicable in exceptional cases, we must perforce be content with approximative methods. This epithet, however, cannot be applied to any method where sections five millimetres thick are made of important parts. In the interior of such a section there is always plenty of room for foci of morbid material sufficient to produce paralysis or convulsions. The less we find, the greater the number of sections we ought to make.

But whether we make few or many incisions, it seems expedient in every case not to carry them so far as completely to separate the portions of the organ. Even if we only make one single cut, it is always useful to leave in one spot so much of the parts connected as to be able easily to restore the external form of the organ by merely placing the parts together and adjusting them. Many an idea with reference to external appearances has occurred only after the inspection of internal changes has directed our attention to certain conditions: and it is much easier to restore the form and general appearance of an organ when the natural continuity of the parts has been to some extent preserved, than when their connexions have been completely severed.

In those instances in which the necessity of the case demands that the incisions should be greatly multiplied—as, for example, in the brain and spinal cord—it would be utterly impossible to form any further opinion as to the extent of certain changes, or even as to their exact locality, or their relation to the vessels, etc., if the parts have been completely divided. It often happens here that, only at a late stage of the examination, changes become prominent, which render it desirable to re-examine, once or more frequently, all the cut parts in their natural order of sequence, to convince ourselves that nothing has been overlooked in our first examination. Very simple precautions are required to rearrange the parts of an organ thus dissected: it resembles a book, the leaves of which can be opened here and there, or even entirely separated, and then again closed. But the object in having a book bound is to secure to every leaf a definite place, where it can be found in a moment without much trouble.

The question now arises as to the place to be selected for the "binding of the book." A close consideration of the relations of each separate organ enables us to answer this question with facility. The continuity must be in all cases preserved exactly where the connection between the organ and adjoining parts is the most important.

In all the large glandular organs, as in those which resemble glands (the spleen and lungs), the incision should be made from the outside, and we should take care of the spots where the vessels enter and leave, where the excretory ducts make their exit, and where the nerves reach the organ. These spots are called the hilus, porta, or root — the name varying with the organ. If, after the incision has been made, the organ is found to exhibit any important alteration, which may possibly be due to a primary vascular lesion, or be the result of some slow morbid process in the excretory ducts, we can, if the hilus has been preserved, either probe, dissect, inject, or use the blow-pipe from the more distant portions of the vessels or canals. If one of these methods is unsuccessful, another of them will be practicable.

The circumstances are different in the case of the brain and spinal cord. Here the only "binding" is the pia mater which supports the vessels. Transverse incisions must therefore be made on the spinal cord, leaving the pia mater attached on the anterior or posterior surface, according as the incision has been made from the one or the other aspect. In the brain the incisions should always be directed through the hemispheres from within to without; so that, notwithstanding the number of cuts which it may be necessary to make in the internal parts, it may always be practicable, at the close of the examination, to put the brain together again. My general rule is that each successive incision should be made across the middle of the existing cut surface, and that each new half should be again and again divided.

This procedure is naturally not practicable in the large ganglia. The optic thalamus and corpus striatum cannot be so divided that the pia mater may serve as a "binding" to them. The reticulated membrane which reaches them, the velum interpositum with its choroid plexus, comes in contact with only a small streak, the so-called stria, or lamina cornea, and must be stripped off before the dissection of the large ganglia is commenced. These latter I divide by fan-shaped radial incisions, whose common starting-point is the peduncle of the cerebrum. However great the number of these incisions may be and it is necessary here to make numerous cuts,—the relationship of the parts may always be closely preserved in consequence of the connection between each separate portion and the peduncle of the cerebrum.

Before I go on with my description, this appears to me to be the place to say a few more words with reference to the examination of the cerebral ventricles, in order to conclude in some degree my account of the method of dissecting the brain. My opinion is that the examination of the brain, after the membranes have been finished, should commence with the opening of the ventricles, since, apart from any tearing or squeezing caused by manipulation, the very weight of the organ increases the liability to laceration as time goes on, and the consequent risk of the escape of the fluids. The first incision, therefore, which I generally make into the brain, is carried directly into a lateral ventricle.

This incision, however, is not to be made in the way very common, even now, in examining the lateral ventricles for descriptive anatomy. The custom is, first to expose the so-called centrum semi-ovale of Vieussens, and then to create cerebral ventricles—perhaps by digging, almost in mining fashion, with the handle of the scalpel. We ought rather to bear in mind that between the middle portions (cellae mediae) of the lateral ventricles there is only the very thin septum lucidum to form a partition-wall, and that it is exactly under the raphe of the corpus callosum. If we therefore make a lateral incision, at a distance of one millimetre from this raphe, perpendicularly into the corpus callosum, we come directly into a cella media at a depth of two to three millimetres. This incision, which forms a right angle with the plane of the centrum semi-ovale, should be the first one made in the brain, unless a deviation is rendered necessary by any peculiar circumstances.

But this incision is naturally not sufficient to open the ventricle completely. In order to open the anterior and posterior cornua, or, at least, to demonstrate their condition (for the posterior cornua are more frequently completely or partially obliterated than open), it is necessary to make particular incisions anteriorly and posteriorly. These should not be made vertically, but horizontally, the anterior one higher, the posterior one deeper, in the anterior and posterior lobes of the brain. Then only we obtain a view of the lateral ventricles in their whole extent, for the entrance, at least, to the descending cornu is also exposed by the incision towards the posterior cornu.

Having determined the contents of the lateral ventricles, the state of their walls and venous plexus, and the condition of the septum, the latter is taken hold of with the left hand close behind the foramen of Monro, the knife is pushed in front of the fingers through this aperture, and the corpus callosum cut through obliquely, upwards and forwards, and then all these parts (corpus callosum, septum lucidum, and fornix) are carefully detached from the velum interpositum and its choroid plexus. After these two latter have been exposed, we have to examine the state of their vessels and tissue. Then the handle of the scalpel is passed from the front, under the velum, which is thus detached from the pineal body and corpora quadrigemina, the state of these parts is determined, and the third ventricle now exposed. Lastly, with a long perpendicular incision, we divide the corpora quadrigemina and the cerebellum as far as the aqueduct of Sylvius and the fourth ventricle.

In the case of the brain, the pathologico-anatomical examination has to take a course peculiar to itself, and one which differs in many respects from that adopted in descriptive anatomy; and the above statement may suffice to demonstrate the most convenient and rapid method of dissecting with a view to a certain object. It at the same time most clearly shows that here also a free incision is to be preferred to any other mode of division, and, as I again repeat, the incision should be made by traction. It is of the greatest consequence that the incisions should be even and smooth in an organ like the brain, where the separate portions are of so great importance, and where one part is distinguished from another by peculiarity of function. How could we possibly demonstrate small foci of softening or induration upon an uneven, crushed, or torn surface? And these two are exactly those changes most frequently occurring in the brain. Therefore I say to my students, "Smooth, though wrong, incisions rather than correct and uneven ones!" It is true that with an incision made in a wrong direction we can scarcely tell what we are about, but an incision badly made is entirely worthless.

On account of the importance of the subject, I shall now describe in detail the examination of a second organ, in order to explain the peculiarity of my method and the reasons for adopting it.

What I refer to is the dissection of the heart; and although the general principles which I have laid down apply also to this organ, yet the details to be taken into account are so multifarious that numerous modifications of the general rules become requisite.

After we have opened the pericardium and determined its condition, and also ascertained the external appearance and the position of the heart, its size, shape, colour, consistence, the amount of blood contained in the superficial vessels, the amount of fat in the sub-pericardial tissue, etc., we have then to open the heart,—and we should do this *in situ*. In making this first opening, we have in view two objects: the determination of the quantity of blood in the separate cavities, and the examination of the capacity of the auriculo-ventricular orifices. Such an examination is, of course, indispensably necessary. The determination of the quantity and quality of the blood contained in the different parts of the heart is of decisive importance for ascertaining the kind of death. It is in the highest degree probable, even if not absolutely certain, that two of the most important kinds of death—that from asphyxia (*Erstickungstod*), and that from paralysis of the heart (*Herzschlag*, *Apoplexia cordis*)—occur in consequence of the over-filling, in the first case, of the right ventricle, in the second, of the left. We must, however, for clinical, and partly for forensic purposes, examine the capacity of the auriculo-ventricular orifices, especially of the one on the left side.

Another question which may be raised with reference to the auricular-ventricular orifices can, unfortunately, only in certain cases be answered from sufficient evidence. I refer to the question with regard to their capacity for closing (*continentia*, less accurately though more frequently described as *sufficientia*). In an ordinary post-mortem examination no method can be adopted whereby the capacity for closing of the auriculo-ventricular valves can be thoroughly tested. We must content ourselves with supplying this deficiency by a minute examination of the valvular parts; and I will here remark that for this purpose it is absolutely requisite to preserve in their integrity all the parts belonging to the auriculo-ventricular valves, therefore also the chordæ tendineae and the musculi papillares.

A consideration of the two objects to be kept in view in making the first opening in the heart teaches us that on both sides the base of the organ must be preserved,—for to the base on the right side the slips of the tricuspid valve are attached; on the left side those of the mitral; and, therefore, if we cut through the base, we injure at least one of the slips of these valves on each side. In addition to which it would be quite impossible to estimate the quantity of blood contained in each side, therefore also in each auricle and each ventricle, unless we open each of them separately. It therefore follows that for the first portion of the examination of the heart four separate incisions are required.

There can scarcely be any dispute as to the position and direction of these incisions. The mechanism of the heart allows no great choice with regard to the spots to be selected. Variations are possible only within certain limits. My method of dissecting the heart may be described under the following heads:—

1. The right border of the heart is the natural and recognised place of incision for examining the right ventricle. The incision must here begin close to the base, and must be carried at once deeply and forcibly into the interior of the ventricle; towards the apex the knife must be brought out without going too far down, for otherwise there is considerable risk of cutting the septum.

2. This incision is at the same time the guide for the three others; and the place for the incision for each separate portion of the heart is to be found in a plane taking the direction of the first incision.

3. The incision for the right auricle commences half-way between the places of entrance of the venæ cavæ, and ends just in front of the base.

4. The incision for the left auricle commences at the left superior pulmonary vein, and ends in like manner just in front of the base, which is usually indicated by the very prominent coronary vein. We should carefully avoid injuring the coronary vessels.

5. The incision through the left ventricle begins just

behind the base, and ends just short of the apex. It must be carried deeply and forcibly through the wall of the heart.

6. To bring the heart into the right position for the dissection, when the incisions for the right side are to be made, I extend firmly the forefinger of the left hand, and push it under the heart, and keep it against the base, so that the ventricular portion hangs down over the forefinger, which is as a fulcrum to it (*Hypomochlion*). Then I turn the heart on its axis towards the left until the right border presents anteriorly, and I press the thumb of the left hand just behind this border at the base. When the heart is thus fixed, I make, one after the other, both the incisions for the right side.

7. In dealing with the left side, I seize the apex of the heart, draw it upwards and to the left, and place the heart in the left hand in such a way that my fingers can encircle it. Then, with gentle pressure, I make the posterior wall to bulge out a little, and withdraw itself from the septum. Then I make in like manner, one after the other, the incisions for the left side.

So much for the method to be adopted in making the incisions. I have now described in a connected way all that is necessary; but in practice the determination of the quantity of blood contained in the chambers, and of the size of the auriculo-ventricular orifices, intervenes during these operations. That is to say, after making the incisions in the right side of the heart, I first remove the blood from the right auricle, and determine its quantity and quality; then I insert two fingers of the left hand (the index and middle fingers) from the auricle through the tricuspid opening into the ventricle, and endeavour to open this latter cavity. Then I remove the blood from the right ventricle, and determine it as before. I then do the same on the left side.

With reference to the examination of the auriculo-ventricular orifices, I may again remark that in this first stage nothing but their size should be ascertained. The examiner must therefore not be tempted to introduce his finger at present for the purpose of feeling whether, and to what extent, the valves are altered. This can be done later on, when the parts can not only be felt and handled, but are also fully exposed to view. Every attempt now made to ascertain, by feeling or rubbing, the condition of the borders of the valves is calculated to produce alterations or to remove any that may be present: any adherent coagula, for example, may be easily broken up or altogether detached. When the two fingers have been introduced, and the size of the orifice determined, they must be withdrawn as gently as possible. I shall here remark that each individual examiner must find out for himself by experience how far his fingers are a measure of the normal size of the orifices. For thin fingers, as in my own case, we may assume that the tricuspid orifice permits the introduction not merely of the index and middle fingers in apposition, but that we may separate the two fingers to such a distance from each other as to be able to introduce between them from the ventricle a third finger, *e.g.*, the index finger of the right hand. With large and thick fingers this is not practicable. We have, moreover, on the left side to take into consideration the contracted condition of the heart. If the left ventricle is strongly contracted, the contraction will extend to the base of the heart, which is equivalent to the base of the orifice. We must then gently press the walls asunder, in order to overcome the contraction and the rigor mortis which is also very often present; this can be done without difficulty. It is only after the state of contraction has been overcome that we are able to form an opinion as to the actual size of the orifice.

These investigations terminate the first act in the examination of the heart. The removal of the heart is the first step of the second act. To do this we seize the organ by introducing the index-finger of the left hand into the left ventricle, and the thumb into the right, through the already existing incisions. We then raise up the apex, and with it the whole of the heart, and then, with three or four long, free, horizontal incisions, we divide the venæ cavæ and the pulmonary veins, the pulmonary artery and the aorta, all together, taking care that the incisions are not too close to the heart. When the heart has been removed, we first examine the cut openings of the aorta and pulmonary artery, determine the size of these vessels and the thickness of their walls, and remove from them any existing coagula.

Then we investigate the capacity for closure of the arterial orifices by pouring water into the aorta and pulmonary artery. Before we do this, we must be always certain that all coagula have been removed, not only from the vessels, but also from the orifices and the ventricles. For it is clear that coagula in any of these parts may so occlude an insufficient orifice as to give the impression of one that is sufficient. When the water is poured in, the heart must be held freely suspended in the air, for, if it is supported, a portion of the wall of the heart may be brought in contact with, and may stop up, the orifice we are examining. We must also avoid taking the heart in the hand and encircling it with the fingers, for we should in that way compress it, and prevent the escape of water through the orifice. The proper plan is to fix the heart by applying the points of the fingers of both hands either to the vessels to be examined, or externally near the base of the valves, in such a way that the plane of the orifice is exactly horizontal, and not drawn to any side. For in an oblique position of the orifice the weight on the separate portions of the valve becomes unequal, and fluid may escape through a valve which would otherwise close; and if the parts be dragged or stretched in a lateral direction, so that the circular lumen of the vessel is made to assume a crescentic form, the conditions of normal closure which involve the coming together of corresponding parts of the valve no longer exist. We must, therefore, always use both hands in order to suspend the heart properly, and the water must be poured in by a second person.

The best way to suspend the heart, when we are examining the aortic orifice, is to find a series of points where the tips of the fingers can be closely applied round it, and these are to be found on the right and left auricles and pulmonary artery. To apply one's fingers simply to the edges of the opening in the aorta is always somewhat hazardous, for there is then only room to hold the vessel in two places; and if we limit ourselves to these, we are always apt to stretch the parts unequally. Moreover, in every case the aorta should be again divided at a distance of four or five centimetres above the orifice, by an incision parallel to the plane of the aperture. We are then able, while the water is being poured in, to observe the condition of the separate portions of the valve, and to ascertain positively the spots where the water escapes. I make, in conclusion, one remark—that sometimes the water sinks, and finally quite disappears, without passing away through the orifice. In this case it usually escapes through the coronary arteries, which are often divided when the left side of the heart is first opened. Particular attention must therefore be paid to this point.

In the pulmonary artery the majority of these difficulties do not exist; we can therefore, without any further preparation, almost always contrive to suspend the heart for the purpose of testing the pulmonary orifice by fixing between the fingers the edges of the opening into the vessel.

We now come to the third part of the examination of the heart: the opening of both the ventricles.

For this purpose, the best plan is to place the heart exactly in the position which it occupied in the body, upon a board or table, and then to make the necessary incisions.

This has the advantage of exposing to view the directions the incisions are to take. The interior of the heart ought by means of the following incisions, to be made so far accessible to eye and finger that the parts remaining to be examined can be conveniently reached. Among these we must mention, in the first place, the auriculo-ventricular valves with their chordæ tendineæ and musculi papillares. Afterwards come the cavities themselves, their endocardial investment, the arterial valves, the septum between the ventricles and that between the auricles, and the muscular substance itself. The auriculo-ventricular valves are here first mentioned, not on account of their peculiar importance, but because the want, previously alluded to, of a proper closure test for them makes it requisite to subject them to a much more minute examination, and to preserve them in their integrity until this has been done. With regard to the arterial valves, which have meanwhile been thoroughly tested and examined with reference to their capacity for closing, the same kind of care is no longer necessary. These considerations determine the directions of the incisions requisite for the complete opening of the ventricles.

(*a*.) The incision for the right ventricle is in a straight line prolonged from the pulmonary artery, and near the base of the heart. The best instrument for this purpose is a long pair of scissors, such as those used for examining the intestines. One blade of the scissors is inserted into the previous incision made in the right border, and carried in a direction towards the pulmonary artery. There is just one thing to bear in mind, and that is, that in this direction we come upon the anterior papillary muscle of the tricuspid valve with its chordæ tendineæ; and this must be carefully preserved. If this or its chordæ tendineæ be cut through, we shall not be able subsequently to demonstrate perfectly the arrangement of the valves of the tricuspid opening. The blade of the scissors must be introduced in front of this papillary muscle, and the incision through the anterior wall of the ventricle and of the pulmonary artery must, as described, be carried close to the base.

(*b*.) The incision for the left ventricle, which should also be made with a long pair of scissors, is in a straight line prolonged from the ascending aorta, and close to the septum ventriculorum. It commences at the apex of the heart, and divides the anterior wall of the ventricle and of the aorta. The part which here requires the greatest care and attention is the base of the mitral valve; and the explanation of this is as follows:—If we cut directly upwards from the apex of the heart to the aortic orifice, keeping too close to the septum, the incision will cross the pulmonary orifice, and, by simply continuing the same, we shall cut through the valves of the pulmonary artery. This can be avoided by drawing the pulmonary artery to the right when making the incision, and by continuing this to the left, close to and behind the artery. But we must not go too far towards the left; there is a Charybdis here to be avoided. The right border of the base of the mitral valve is inserted quite close to this spot, and this valve, as is well known, is connected immediately with the left border of the aortic orifice. If the incision goes only a few millimetres too much to the left, we shall cut off that portion of the mitral valve which forms the above-named junction; and then, if we attempt to put together the divided portions of the heart, we shall find an aperture in the mitral valve. Externally, this spot corresponds exactly with the right border of the base of the left auricle. This should be our guide. The incision must therefore be carried through midway between the pulmonary orifice and the left auricle.

The principal part of the examination is now finished. The auricles can, however, be still further opened by cutting through their wall with the scissors, between the openings of the venæ cavæ on the right, and of the pulmonary veins on the left side. Further incisions can also be made into the muscular substance; for example, some very important ones running parallel to the surface from those last made in the ventricles, and which divide the wall of the heart into an inner and an outer half. The coronary arteries can also be further slit up, the incisions hitherto made having, upon the whole, but little interfered with these vessels. In exceptional and peculiar cases, such steps as these may have to be taken; but, as a general rule, the examination is completed in the three acts which have been detailed, and which are also indispensable. The heart cannot possibly be regularly examined unless these three acts are properly performed.

One might suppose, after reading the long description which I have just given, that it would take a long time for all this to be carried out. The reader's idea might be similar to that of an unfortunate district physician, who, after studying the new Regulations, came to the conclusion that to make an autopsy in the prescribed manner would require at least two days. The one notion is as erroneous as the other. Ten minutes are sufficient to examine the heart in the way I have described, and an autopsy can be performed according to the new Regulations in three hours, and even in two where there are but few complications.

In order to be able to judge for myself as to the requirements of the Regulations, I have taken a few suitable cases, and made the post-mortem examinations in the prescribed form. I give, by way of a supplement, the notes of these examinations as instances, and also, in a certain sense, as models. I do not mean that they should (like Caspar's autopsies) serve as examples of diction and technics, and should relieve those who make examinations from describing and specifying in their own way what they find before them; but what I intend is that they should show what a report is like when the Regulations have been carried out. A certain amount of freedom has been used in dictating these notes, and a very critical eye may possibly discover a few places where the Regulations have not been complied with, and some strictures may be made thereupon. But these, I hope, are such subordinate points that there will be at least no necessity for any "revision notes" (*Revisionsbemerkungen*) in the sense in which this word is used by the Committee of Sciences.

The cases which I have selected are also of some interest in other respects, and I shall take the liberty of interpolating a few critical remarks.

## CASE I.

A man unknown. Dead when brought in; face covered with blood; left side of face, particularly about the ear, of a bluish-red colour. Death from suffocation caused by pulmonary haemorrhage and oedema.

Length of time occupied in the examination, two hours and five minutes.

### A. *External Examination.*

1. The body is that of a man apparently from forty to fifty years of age; height 1·75 metre (68·89 inches); very strongly built; adipose tissue slight in quantity; muscles greatly developed,—those of the arm and thigh less so in proportion than those of the forearm and leg.

2. Body generally pale in colour; abdomen slightly green; flanks posteriorly, scrotum and glans of a uniform bluish-red; dorsum the same, and pale only where exposed to pressure; on pressing with the finger this bluish-red colour can be made to disappear, not easily, though tolerably completely. On an incision being made, only distended vessels are visible in the skin and subcutaneous tissues, from which fluid blood escapes.

3. The body being turned over for the purpose of this examination, a thin sanguineous fluid escapes from the nose and mouth.

4. The face, particularly the left side as far as the ear, and the beard are much soiled with dried blood, the largest quantity being on the nostrils and lips. A brownish-red, dry, powdery substance, on the left side converted into larger coherent crusts of dried blood, covers the neck and upper part of the chest.

5. Hair of head abundant, curly, light brown in colour; numerous scattered grey hairs. The beard full, especially about the chin; whiskers strongly developed, colour more reddish-brown: eyebrows thick and, like the eyelashes, of a dark greyish-brown colour; pupil pale greyish-blue; face large; forehead prominent; nose large and straight; high cheek-bones; front teeth perfect; molar teeth more or less carious and defective; no traces of recent injury; lips pale and thin.

6. The body presents no other particular characteristics, only that the prepuce is unusually short, and covers no more than the edge of the glans; there is, however, no cicatrix of any kind to be seen.

7. The hands large; the nails long and bluish, the projecting edges filled up with thick black dirt, traces of which are seen also in the palms of the hands.

8. There is some amount of mobility in the principal joints of the extremities, but there are signs of rigor mortis in all the smaller articulations.

9. The eyelids are only partially closed; the cornea transparent, and comparatively tense.

10. No foreign body about the nostrils, with the exception of the blood already mentioned.

11. The lips, as well as the teeth, are slightly parted; the tongue is behind the teeth, and, like the palate, covered with fluid blood.

12. External parts of ears unusually large; the left ear of a dark brown-red colour. On an incision being made, blood flows everywhere copiously from the divided vessels,

but there is no sign of extravasated blood in the tissue; auditory meatus empty.

13. Neck not very easily movable; no change perceptible.

14. Chest full; abdomen slightly distended.

15. Cutis anserina slightly marked on the extremities, especially on the lower ones; the legs above the ankles rather large, pitting on pressure; the tissues on section found to be infiltrated with fluid. Just above the ankles there is a loose knotted piece of cord, twisted round each of them; corresponding to this there is a transverse indentation on the inner and anterior aspects. This, when cut into, exhibits no extravasation of blood.

16. The parts about the anus much soiled with brown excrement; the anus closed.

17. In conclusion, there is no perceptible mark of external injuries.

### B. *Internal Examination.—a. The Cranial Cavities.*

18. The soft parts covering the skull are divided, as directed, by an incision carried transversely over the head, and reflected back. All these parts are then seen to be somewhat red in colour, the alteration being more marked posteriorly than in front—the redness, however, not being sufficiently distinct on any one spot for it to indicate extravasation: on the other hand, thick blood exudes everywhere from the divided vessels, and the soft parts appear to be uniformly infiltrated with reddish serum.

19. The skull-cap, very broad and much arched, exhibits posteriorly a similar reddish infiltration of its tissue, especially at the sutures, which are deeply indented, and furnished in various places with ossa triquetra. The colour of the remaining portions of the skull-cap is a dirty yellowish-grey, somewhat more whitish in isolated spots.

20. The skull cap is sawn through with difficulty, and, when divided, cannot be taken off from the tough dura mater. The latter is therefore immediately cut through. On attempting to detach the bone and dura mater, the brain also follows, and this latter has to be removed by separating methodically its connections in the base of the skull.

21. The brain being removed, there is no appearance of serum nor of any other effusion on the basis cranii. The large sinuses in that situation contain only a moderate amount of fluid blood.

22. There is some difficulty in separating the tough dura mater from the base of the skull and the posterior portions. There is no sign of any kind of injury to the bones of the base.

23. There is no change, also, on the base of the brain itself. The great arteries are large, but flat and empty. The pia mater everywhere fine and soft, and its veins only filled with blood near their origin.

24. After the removal of the brain from the roof of the skull, the inner surface of the dura mater is found to be everywhere of a pale colour. There is no deposit connected with it; it is somewhat thick and tendinous; the longitudinal sinus large, but filled throughout with fluid blood.

25. The dura mater is then removed from the roof of the skull. Its external surface is also pale; the blood-vessels very prominent, but empty.

26. Neither fissure nor injury of any kind visible in the roof of the skull; diploe scanty in amount. The bones, on an average, are from five to six millimetres thick. Fine, red, very vascular, soft growths on the inner surface of the frontal bone in the middle line.

27. The surface of the brain well formed; the pia mater delicate throughout; the veins filled with blood, tumid

even to roundness on the left side, somewhat less so upon the right.

28. On cutting into them, the lateral ventricles are found to contain a small, inappreciable quantity of clear fluid. Cavities of normal size; posterior cornua obliterated. Septum soft, and easily torn; choroid plexus and vessels of the velum of a dark red colour, owing to great distension. The vessels separable only with difficulty from the corpora quadrigemina.

29. On cutting into the hemispheres of the brain the tissue is found to be moist and glistening; the white substance exhibits numerous bloody points, from which drops of blood exude on pressure; these drops can be washed away with water. The grey substance of the cortex pale reddish; that of the corpus striatum and of the thalamus similar in appearance, and also moist. No other change. Consistence of the brain good.

30. Corpora quadrigemina pale. Pineal gland small and red.

31. The fourth ventricle empty; its surface pale and soft, its choroid plexuses reddened.

32. The cortex of the cerebellum reddened throughout, though the vessels are not perceptible; the medullary substance, on the contrary, traversed by congested venous branches. Consistence good; moisture moderate in quantity. No change.

33. At the base of the brain, all the lobes cut through by numerous parallel transverse incisions; no alteration of any kind apparent. The grey substance slightly reddened throughout.

34. The grey substance of the pons Varolii and the cerebral peduncles of a reddish colour; the white substance traversed by numerous congested veins. Consistence good.

35. The medulla oblongata pale; the grey matter of the rhomboid fossa somewhat more reddened.

## *b. Thorax and Abdomen.*

36. A long incision is made from the chin to the pubic symphysis as directed, the integuments divided, and the cavity of the abdomen laid open. Adipose tissue slightly developed; muscles somewhat pale.

37. No foreign body in the abdominal cavity. Position of the parts normal. Caecum, transverse colon, and the ascending portion of the large intestine are much distended; also a portion of the small intestine, in part with gas, and in part apparently with fluid. All these parts are pale in colour; the omentum only presents a few distended veins.

38. The arch of the diaphragm on each side is between the fourth and fifth ribs.

### (a.) *The Thorax.*

39. After removal of the sternum the lungs come into view, somewhat distended, particularly the left one; position of the parts normal in other respects. The pericardium to a great extent covered by the lungs.

40. On the left side several very firm adhesions between the surface of the lung and the wall of the thorax. A tablespoonful of thin reddish fluid in the most posterior part of the pleural cavity.

41. On the right side the adhesions to the upper lobe are somewhat more extensive, but equally firm, and traversed by vessels. A smaller amount of fluid than on the left side. Internally, near the pericardium, the adhesions are still more extensive.

42. The pericardium contains a tablespoonful of a slightly reddish but clear fluid.

43. The heart about the size of the man's fist, its right surface flattened, a slight amount of tendinous deposit (*Sehnenflecke*), upon the outside, the right ventricle mode-

rately covered with fat, pale, and only the coronary veins somewhat distended with blood. The right auricle contains particularly fluid blood, mixed with a very small quantity of soft, friable, buffy clot. The quantity of blood collected from the right side of the heart and the large veins amounts to 150 cubic centimetres. The right ventricle contains fluid blood only, inappreciable in quantity. The left auricle contains fluid blood and a small quantity of thick blood. The left ventricle quite empty. The blood everywhere equally dark. The aorta three centimetres in diameter, its walls thick, inner coat especially thickened. The pulmonary artery about the same size, but with thin walls. The valves at the mouths of both vessels close. On section, right ventricle found to be dilated, left ventricle large. Muscular tissue somewhat dark; a little paler on the right side. Valves without alteration, but of a deep red colour.

44. The large veins of the neck moderately distended with fluid blood; arteries empty. The large nerves apparently unaltered.

45. The cavity of the mouth opened, as directed, from beneath; the tongue drawn away, and the upper part of the throat exposed. All these parts covered with a layer of bloody mucus, which, however, can be easily rubbed off; after its removal the mucous membrane appears slightly reddened, but otherwise unchanged. Lingual follicles large, whitish. Tonsils slightly swollen.

46. A considerable quantity of bloody froth with large bubbles in the larynx and upper portion of the air-tubes. This removed, the mucous membrane appears only slightly reddened: on the posterior aspect of the tubes the vessels of the mucous membrane distended with blood, but no other change.

47. The remaining thoracic viscera, with the lungs, are now removed, together with the costal pleura.

48. Lower portion of the œsophagus is covered with reddish fluid, which can be easily taken off. After its removal, no alteration visible in the subjacent mucous membrane.

49. There is slight dilatation, and thickening of the internal coat, of the thoracic portion of the aorta, but no breach of surface. The same may be said of the large branches of the artery going to the neck.

50. The upper part of the air-tubes, as well as their large ramifications, are filled with frothy and bloody matter.

51. The lungs seem large, very concave on their diaphragmatic surface, studded over, especially on the right side, with smooth projections of their tissue greatly dilated (emphysematous). The lungs, in general, are grey in colour, pale anteriorly, reddened posteriorly. Numerous furrows, due to absorption on the anterior surface. These latter places feel harder to the touch; the rest of the tissue is soft, but only slightly crepitant.

52. On section, in the apex of the right lung is found a ramified cavity of irregular shape, about six centimetres and a half in diameter, consisting of two compartments, separated by a thin septum, and each of them four centimetres and a half in horizontal diameter. Each contains a bloody, slightly frothy liquid, which can be easily removed by water. The walls of both these cavities are irregular and rough, and, on water being poured upon them, they are seen to be covered with adhesions, which readily float. Many large eroded vessels, some of them lying free like rafters, are found in these cavities, into which branches of the air-tubes may be directly traced. In other parts of the lung there are single smaller cavities with smoother walls, and also separate circumscribed spots, externally hard to the touch, some of which appear on section dense, dull, greyish-red, and finely granular; others dry, greyish-white, and caseous. The rest of the

pulmonary tissue is full of frothy, whitish fluid, which can be easily pressed out.

53. On the left side, below the apex, more towards the centre of the upper lobe, there are several similar cavities, varying in size from that of a walnut to a hen's egg, containing also fluid, slightly frothy blood, and connected with the air-passages. The wall of these cavities is irregular and ragged; the remains of the large vessels appear as whitish projections. There is a similar cavity about as large as a walnut in the upper part of the lower lobe. Throughout the remainder of the lung there are numerous nodules of varying size—some as large as peas; a few with cavities in their interior; others solid and caseous; others, again, solid and dark grey.

### (2.) *The Abdomen.*

54. Spleen closely adherent to the diaphragm and omentum; fourteen centimetres long, nine centimetres broad, three centimetres and a half thick; externally, grey steel-coloured. On section, dark brown-red; pulp abundant, with numerous dark red spots; follicles slightly enlarged.

55. Left kidney thirteen centimetres long, six centimetres and a half broad, three centimetres and a half thick. Capsule slightly dull, thin. Surface of the kidney smooth, brownish-red, bright; consistence firm. On section, the medullary and cortical substance very red, not dull; no other change. Malpighian corpuscles bloodless. Suprarenal capsule with a small amount of cortical and medullary substance; the tissue connecting it with the kidney firm and well supplied with blood.

56. On separating the parts surrounding the right kidney a fibrous adhesion between the large intestine and the under surface of the right lobe of the liver brought into view.

57. Right kidney of same size as left, and resembling it in other particulars. Supra-renal capsule in a similar condition.

58. Bladder contracted, and containing only a few drops of whitish urine. No change in mucous membrane.

59. Left testicle somewhat mis-shapen in consequence of fibrous adhesions on its surface. An offset from the right one at the upper part of the epididymis.

60. The stomach distended, and containing a large quantity (about 200 cubic centimetres) of thick, clotted, bloody fluid, mingled to some extent with large air-bubbles.

61. Fluid of a similar kind in the commencement of the duodenum, but extending only as far as the opening of the gall-duct. After this the contents are of a pale yellowish colour. Opening of gall-duct normal.

62. The mucous membrane of the stomach tinged throughout with blood, but without any lesion; only the large veins distended with blood.

63. In the upper part of the intestine a large amount of a grey fluid resembling gruel, slightly coloured with bile. This becomes thinner and more scanty in the upper part of the jejunum. The ileum contains a very large quantity of fluid of a brownish colour. This part of the bowel is so soft that it tears when cut into with the scissors. The lowest part of the ileum contains a quantity of very fluid faeces. The large intestine from the ileo-caecal valve full of thick pulpy faeces. The mucous membrane throughout the ileum thin and pale; the glands slightly tumid. In the jejunum the mucous membrane is thicker. Here and there a single gland appears tumid, but in other respects normal. In the upper part of the jejunum the mucous membrane has a whitish appearance.

64. The liver (twenty-eight centimetres broad, twenty-three centimetres from front to back, and eight centimetres

thick, is firm to the touch, its surface of a pale brownish colour, somewhat firm under the knife; breaks with difficulty, and appears on section uniformly red. The lobules are large, and their colour uniform.

65. The inferior vena cava contains fluid blood.

This case is a remarkable instance of ulcerous consumption of the lung, occurring in a man in other respects vigorously developed, and in whom the disease, though obviously of long standing, had confined itself to the lungs. Owing to the advanced stage of the disease, it cannot be ascertained whether the morbid process primarily originated in bronchiectasis or caseous pneumonia; at any rate, caseous pneumonia finally supervened. It is a matter of great interest that, notwithstanding the amount of hæmorrhage from the lung, the fatal result was not due simply to loss of blood (anæmia), nor to simple occlusion of the air-passages by the extravasated blood, but really to the supervention of œdema—a complication which is explained, on the one hand, by the robust condition of the patient; and, on the other, by the slow course of the hæmorrhage. Not a single eroded blood-vessel could be discovered.

The conclusions to be drawn from the foregoing statement are as follows:—

1. That death occurred from suffocation caused by pulmonary hæmorrhage and œdema.

2. That no signs of any external injury were revealed by the autopsy.

## Case II.

A person known. Gunshot wound of head (suicide). Death in twelve hours, or rather more, from œdema of the lungs. On examination post-mortem, the track of the wound found to be through the right hemisphere, and involving the extra-ventricular part of the corpus striatum. Extensive œdema and interstitial emphysema of the lung. Numerous manifestations of older affections: irregularly shaped cranium; unsymmetrically formed brain; contracted aorta; endocarditis mitralis; herpes zoster; chylification going on in the intestines.

B. W., aged twenty-one, a tradesman's assistant, had shot himself through the head with a pocket-pistol above the middle of the left eyebrow. Quite insensible when brought to the Charité at 6 a.m.; breathing stertorous; pulse scarcely perceptible; urine passed involuntarily; loud tracheal rales; heart-sounds scarcely audible; no albumen or sugar in the urine; the left pupil larger than the right. From time to time a whitish greasy matter, mixed with blood, exudes from the small wound. At midday the pulse had somewhat risen; the respiration was still stertorous, though a little easier. In the afternoon the man's condition rapidly changed for the worse, and he died at four o'clock.

Post-mortem examination (occupying two hours and three-quarters):—

### A. *External Examination.*

1. Body generally well-developed; appears to be that of a man of twenty years of age; height, 1·7 metre.

2. Anterior surface generally pale, but the left half of the face, the left ear, the adjacent part of the neck, the arms and forearms, and the thighs and legs much discoloured, and exhibiting large, bluish-red, irregularly shaped spots, of varying size, generally more marked on the left side; but on those parts of the back which have not been exposed to pressure the discoloration is uniform and of a deeper red. On pressing firmly with the finger the redness almost entirely disappears; on an incision being made, a few large drops of semi-fluid blood escape from the skin and subcutaneous tissue, but there are nowhere any permanent reddened patches, such as cannot be removed by water. There is one place on the left thigh, a hand's-breadth above the patella, where, on incision, we find a

small spot extending through the adipose layer, and infiltrated with blood which cannot be pressed out. On the right shoulder-blade there are a few dry, brownish-red spots running obliquely from above, and externally in a direction downwards and inwards. These on section appear to be only thin dry crusts involving the corium proper.

3. On turning the body over, a large quantity of yellowish brown fluid, containing dark-brown particles, escapes from the mouth.

4. Rigor mortis marked in the extremities and in the muscles of the neck and abdomen.

5. Numerous greyish-brown spots—not to be removed by washing—on the anterior surface of the body, especially on the breast. On the left side, near the seventh, eighth, and ninth ribs, there is a broader zone of these spots: this is continued to the arm, where the patches are brownish, and covered with thick masses of epithelium. Other parts, also, of the surface of the body, especially the lower extremities, are covered with grey spots, completely removable by washing. Blackish marks on many parts of the face, neck, arms, and trunk: some of a larger size on the abdomen; these appear, on section, to extend no further than the cuticle.

6. A few pale-greenish faint spots on the abdomen and in the neighbourhood of the groins. Cadaveric odour not perceptible.

7. Hairs dark brown, on right side stained red: much matted together, and their roots covered with dry blood.

8. On the forehead, a finger's-breadth above the middle of the left eyebrow, a small hole three millimetres in diameter, surrounded by a dry, blackish-brown, somewhat depressed border of skin, one to two millimetres broad, around which externally and towards the left side the integument is slightly reddened, and the cuticle abraded. The parts surrounding the wound are slightly swollen. A long transverse incision carried down to the bones shows

extensive separation of the connections of the tendinous expansion and the subjacent connective tissue, extending in one spot to the periosteum, and corresponding with a hole in the bone. There is here a flat splintered piece of bone, triangular in shape, five millimetres long, four millimetres wide, retained in its place. The separation thus caused in the parts forms no regular cavity; the wound is traversed by numerous projecting filaments and cross-bands of tissue. For five centimetres around this the soft parts are infiltrated with blood, which cannot be pressed out. The tissues for some distance beyond this contain a watery fluid.

9. Eyelids open; corneæ firm and transparent.

10. Nostrils filled with a great quantity of dried blood, which also covers the adjacent parts of the skin.

11. Mouth slightly open at its middle. Lips somewhat red. The teeth closely shut.

12. No other foreign bodies discovered in the apertures of the head.

13. A pale streak on the neck, three millimetres broad, over the larynx, increasing towards the left side to a breadth of fifteen millimetres, and terminating here under the ear; neither a groove, nor injury of the surface, nor any change of colour to be perceived. There is nothing of the kind to be seen on the right side. The skin and subcutaneous tissue quite pale on section.

14. Thorax somewhat flat.

15. Abdomen somewhat retracted.

16. Penis small; much contracted; very little prepuce. The glans and what remains of the prepuce dark red and rather dried. The scrotum likewise small and much wrinkled; externally on both sides some appearance of blood. On incision the integuments of these parts dry superficially and very red.

17. Anus closed.

### B. *Internal Examination.—a. The Cranial Cavities.*

18. Scalp divided by an incision across from one ear to the other, and reflected forwards and backwards. A few drops of blood seen emerging from the anterior portion—these more numerous posteriorly: in front also a close network of distended vessels in the aponeurosis and pericranium. No other spots of extravasated blood, with the exception of those mentioned (in No. 8) in the left frontal region.

19. The aperture mentioned in No. 8 is now seen more distinctly; but there are no fissures surrounding it, and no increase in the quantity of blood in the periosteal vessels.

20. The skull-cap is now removed, the saw being carried horizontally round below the aperture. The bones are difficult to saw through, and on being removed are found to be almost entirely composed of compact substance, and six or even seven or eight millimetres thick. The left frontal sinus is filled with pulpy matter, consisting of whitish, soft, brain-like substance, and dark-red clots, which are partly separable. The right frontal sinus is empty. No fissures are visible in the bones forming the sinuses; but the vessels, as far as they can be made out with the naked eye, are much distended with blood. The external opening (the transverse diameter of which in the outer table is eight millimetres, the diameter from above downwards being six millimetres) has an irregularly hexagonal shape, and leads directly into the left frontal sinus. In this sinus there is another opening, having the same direction, and passing through the inner table just above the orbital plate. This opening is almost completely closed by fragments of cerebral matter and clots of blood; after these are cleared away, a somewhat irregular, but here rather triangular, opening is found, the sides averaging six millimetres. At the upper part, and close to the opening, there are two larger and two smaller scales of

bone, splintered off from the inner table; these are, however, still loosely connected with the bone.

21. The form of the skull is seen on section to be somewhat oblique, the right half becoming wider posteriorly, the left narrower in front. On the left side there is incipient obliteration of the coronal, as well as of the spheno-parietal suture. The right lambdoidal suture is completely obliterated. On removing the pericranium, recent red osseous deposits on various parts of the surface of the skull, especially numerous on the posterior upper part of the temporal ridge. The inner surface of the calvaria dotted over with numerous large pits, principally in the neighbourhood of the anterior fontanelle.

22. The dura mater everywhere thin and diaphanous, except in the neighbourhood of the longitudinal sinus, where it is of a dull whitish colour, and traversed by numerous red vessels. On the left side, in front of the anterior part of the brain, there is an aperture in the dura mater, very irregular in shape, out of which protrude soft broken-up masses of brain substance, mixed with blood; these are continuous with the previously mentioned *débris* in the aperture in the skull. The opening in the dura mater is on an average from six to seven millimetres wide; its margins are somewhat dentate and wrinkled. There is no blood extravasated anywhere else between the dura mater and the bone.

23. The superior longitudinal sinus anteriorly narrow and empty; posteriorly, rather wide, and filled with dark semi-fluid blood.

24. On the right side, the dura mater much distended by a bluish mass, which gleams through it. The arteries of the dura mater filled with blood as far as their small ramifications, and projecting considerably above the surface of the membrane.

25. On separating the dura mater on the right side, a large clot of blood, dark-coloured, is found to overlay the whole right hemisphere of the brain. It is slightly moist; its own weight causes it to slide from its position; and it amounts in quantity to twenty-five cubic centimetres. Some portions adhere pretty firmly to the surface both of the dura mater and of the pia mater. On washing the parts with water, the source of the haemorrhage is found in an aperture in the brain, situated nearly at the posterior part of the middle lobe, two fingers'-breadth behind the end of the fissure of Sylvius; clots of blood protrude from this opening. The pia mater all around this spot is infiltrated with blood, especially at the anterior perforated spot; also to a less degree in the sulci of the middle and posterior lobes, and to some extent in those of the anterior lobe.

26. At the anterior extremity of the right anterior lobe, close to the falx cerebri, the pia mater appears more thickly and deeply infiltrated. This appearance is not connected with those above described; it is more marked inferiorly and in front, where, at the same time, the consistence of the cerebral substance is softer and more yielding.

27. A third, apparently also independent spot, is quite close to the longitudinal fissure at the top of the vertex, under a somewhat thickened part of the pia mater; it projects somewhat, and is surrounded by a quantity of fluid blood, which spreads also freely towards the dura mater.

28. The head being raised and drawn forward, a leaden bullet, measuring in one direction eight, in the other six millimetres, falls from the parts described in No. 25. This bullet is quite flattened, and bright on one side.

29. Sulci of brain on right side very deep; perceptible bevelling off of the convolutions just behind the vertex.

30. The dura mater being removed on the left side, blood is found effused on the surface in much less quantity: it is, however, equally coagulated, and is more adherent to the membranes, especially to the dura mater. The pia mater infiltrated with blood, but only to a slight extent, anteriorly near the spot where the external opening touches the brain, the infiltration extending no further than a finger's-breadth towards the base, and not quite so far towards the convexity of the brain. A clot of blood eleven millimetres long and five millimetres thick in a small depression of the surface close by the side of the falx cerebri, on the margin of the longitudinal fissure at the vertex; this extends a finger's-breadth further backwards than towards the right side. All around the spot the vessels are much distended, and posteriorly the pia mater infiltrated with blood.

31. There is, in addition, an extravasation of blood in shallow layers between the falx cerebri and the projecting wall of the left hemisphere, amounting in quantity to scarcely a teaspoonful.

32. The left hemisphere of the brain also appears depressed: the surface of the convolutions is even flatter than on the opposite side.

33. The brain being removed, its base is seen to be infiltrated with blood to an irregular extent: this is especially marked in the direction from the aperture in the anterior lobe towards the olfactory nerve, at the anterior part of the middle lobe, around the infundibulum, as far as the pons Varolii, and even in places as far as the medulla oblongata. The blood for the most part is contained in the meshes of the pia mater, but in several places there are clots obviously non-adherent.

34. The pia mater delicate throughout, its vessels filled with blood up to the smaller branches.

35. The brain itself appears shorter, and the convolutions more simple, on the left side than on the right. The consistence good, with the exception of those spots already mentioned.

36. Behind the above-mentioned (No. 22) opening in the dura mater, corresponding to the aperture in the bone, and which is just below the anterior part of the left anterior lobe, there is also a large perforation in the pia mater, fourteen to eighteen millimetres in circumference. Beneath this there is a funnel-shaped excavation, surrounded by soft *débris* of brain-substance, and a few large clots of blood. An oblique incision being made, extending from this spot transversely across to the opening (mentioned in No. 25) in the outer part of the right hemisphere, a continuous canal is exposed: this has a total length of thirteen centimetres, and extends through the middle of the brain-substance, particularly through the base of the corpus striatum, and has a diameter anteriorly of twelve millimetres, posteriorly of eighteen millimetres; it is filled with coagulum and copious *débris* of brain-matter. The wall of the canal is soft throughout, formed directly of brain-substance, and dotted over with numerous spots of extravasated blood.

37. The point on the vertex of the right hemisphere (described in No. 27) turns out to be a sanguineous infiltration of the pia mater, five millimetres deep. Nothing abnormal found below the other spot particularly referred to in No. 26.

38. The cerebral ventricles are empty, the choroid plexus and the large vessels of the walls of the ventricles filled with blood. The upper vessels of the velum delicate and transparent.

39. Optic thalamus and corpus striatum pale, but not dry.

40. The white substance of the hemispheres is pale and dry; in a few places only, blood escapes from the divided vessels. The grey substance for the most part pale, but in places reddened to some depth.

41. The fourth ventricle is empty; the cerebellum generally pale, but less so on the left side, where the grey substance is somewhat reddened; and the white substance appears to be more infiltrated with a watery fluid.

42. The pons is pale and firm, as is also the medulla oblongata.

43. In the posterior fossa of the base of the skull a large quantity of fluid blood has collected during the examination; this has escaped from the large blood-vessels of the vertebral canal.

44. The transverse sinus almost empty. In the middle fossa of the base of the skull, on the left side, the dura mater much covered with blood.

45. On removing the dura mater, it is found that several fissures of the inner table extend from the opening in the skull (No. 19, 20) to the orbital plate. The cracks are filled with coagulated blood, but they extend for a distance of only seventeen to eighteen millimetres in a backward direction.

## *b. Thorax and Abdomen.*

46. A continuous incision, carried as directed from the chin to the pubic symphysis, and the abdominal cavity first laid open. Abdominal organs in their normal position. The intestines lie very far back. No foreign body in abdomen. The parts exposed of a pale colour generally; only the small intestines slightly reddened.

47. The diaphragm on both sides reaches the lower border of the fifth rib.

### (1.) *Thorax.*

48. The sternum having been removed as directed, the lungs recede very slightly from the wall of the thorax; their anterior portions distended with air, and buoyant, much reddened in places. Between the lobules there are rows of large air-bubbles; and in some spots these coalesce, and form large, continuous level patches.

49. The left lung is free throughout. The pleural sac contains, at a rough guess, forty-five cubic centimetres of a thin, watery liquid, of a dirty-red colour.

50. On the right side the upper parts of the lungs are somewhat bound down by connective tissue; at the base and back part of the pleural cavity there is a very minute quantity of fluid of a similar kind to that found on the other side.

51. The heart, just the size of the man's closed fist, is very rigid, and somewhat flattened on its anterior aspect and over the right auricle. The coronary arteries empty; the coronary veins distended only in their primary ramifications, and somewhat deeply placed. Only a small amount of fat about the pericardium, on which there are a few small detached spots of a deep-red colour, scarcely as large as a millimetre.

52. About forty cubic centimetres of dark blood, for the most part fluid, containing a small buffy clot, escapes from the right auricle. The right ventricle contains blood of a similar kind, dark-red in colour, not more than twenty cubic centimetres, with very faint traces of coagula. In the left auricle the quantity of blood amounts to thirty cubic centimetres, and it is more coagulated and as dark, with a few spots of a faint buffy colour. On the other hand, only a very slight clot with a gelatinous buffy coat occupies the left ventricle.

53. The aorta so narrowed as only to be capable of admitting the tip of the ring-finger. The pulmonary

artery only a little more capacious. A stream of water being poured in, none passes into the ventricles. Valves on both sides thin; not discoloured by blood. Narrowing of the mitral valve, which will not admit of two fingers, caused by thickening, contraction, and adhesion of the slip of the valve posteriorly. Muscular tissue much attenuated, of a brownish-red colour.

54. On the left lung rows of air-vesicles in great abundance (as described in No. 48) on the lower part of the anterior border, and at the tongue of the upper lobe, and also in various places at the lower border of the lung at the base. Posteriorly, both lobes appear to contain but little air, and are of a tolerably uniform bluish-red colour; the lower lobe somewhat greyish-white, owing to thickening and serous infiltration, here and there, of the investing membrane. Numerous small, slightly raised patches of extravasated blood scattered about over both lobes.

55. A large quantity of thick bloody froth escapes from the left bronchus. On cutting through the lung, entire portions appear red and filled with frothy liquid, but in other respects unchanged.

56. The same appearances are found on the right side, but the rows of air-vesicles are less numerous. On the other hand, all parts of the lung contain serous exudation, and the lung-tissue is of a deep-red colour.

57. The tongue, retracted behind the jaws, is covered with a dirty brown coating, but normal in other respects. Some bloody mucus in the pharynx. Both tonsils very large, projecting almost like tumours, and seen on section to contain friable masses in the follicles; parenchyma much increased.

58. Veins of the neck filled with dark fluid blood. Arteries empty. Nerves normal.

59. Œsophagus contains only a small quantity of light brownish matter.

60. Epiglottis slightly compressed laterally; glottis open. Larynx and air-passages filled with thick frothy fluid, containing a few yellowish-brown flakes. These being removed, the mucous membrane of the upper part is seen to be traversed by an open network of vessels. In the lower parts the vascular network is close, and of a deep-red colour.

61. Aorta narrow, walls thin; contains only fluid blood. The superior vena cava has similar contents.

## (2.) *Abdomen.*

62. The spleen is 14·5 centimetres in length, 10 centimetres in its greatest breadth, and 2·7 centimetres in its greatest thickness; it is very flabby, and somewhat wrinkled. On section, blood exudes from a few large vessels. The Malpighian corpuscles are unusually large, reaching even 1 millimetre in diameter. Splenic pulp scanty and brownish-red.

63. Left kidney 10 centimetres long, 4·5 centimetres broad, 2·9 centimetres thick; flabby; capsule easily separable; surface smooth, of a dark brownish-red colour; veins easily distinguishable. The tissue on section very dark red; Malpighian corpuscles very prominent, but no other change.

64. Left supra-renal capsule firm; cortical substance slightly developed, medullary substance more so.

65. Right kidney 9·2 centimetres long, 4 centimetres broad, 2·5 centimetres thick; in other respects, as on the left side.

66. Right supra-renal capsule resembles left one.

67. Bladder not much distended. Urine clear, and amounting to about 80 cubic centimetres. Bladder normal.

68. A little clear fluid in both tunicæ vaginales. The substance of the testicles pale but normal.

69. The stomach somewhat distended, its pyloric portion contracted; the veins on the external aspect but slightly distended, and only the larger ones manifest; its general aspect pale. It contains about 150 cubic centimetres of a greenish, thick fluid. The mucous membrane of the fundus is stained greenish-yellow, in the other parts pale red, and towards the pylorus somewhat granulated.

70. The small intestine is contracted almost throughout its extent, only the most deeply situated portions are somewhat distended, and contain liquid. On the external aspect the large veins appear very full, as also some lacteal vessels in the upper portions of the bowel.

71. The mesenteric glands small and slightly reddened. Mesentery loaded with fat.

72. The upper part of the duodenum contains a whitish fluid; lower down, the contents are decidedly yellow. On pressing the gall-bladder, greenish-yellow bile flows freely from the orifice of the gall-duct. Pancreas pale: normal.

73. On opening the jejunum it is found to contain some light grey matter, here and there yellowish and consistent: in its lower portion some thinner fluid deeply tinged with bile. The ileum is almost empty, and contains only a few greenish, tolerably consistent faecal lumps.

74. The large intestine contains pulpy, greenish-brown fluid masses, mixed with hard fragments, as far as the descending colon; in this latter portion, consistent and formed faeces.

75. Mucous membrane of the jejunum very thick: the villi in the upper part enlarged and milky from absorption of chyle. Lower down, marked reddening of the valvulae conniventes as far as the place where the contents are coloured with bile: the mucous membrane here becomes also deeply bile-coloured. Lower down, and as far as the beginning of the ileum, the villi are faintly red. Peyer's patches slightly injected, and the glands enlarged in the

lower portion of the ileum. There is also enlargement of the solitary glands close to the ileo-cæcal valve.

76. The mucous membrane of the large intestine very pale, and only in the lower part of a greenish-grey colour.

77. Liver about seventeen centimetres from front to back, twenty-three centimetres broad, and eight centimetres thick; externally greyish-red; smooth and tense; on section, very uniformly reddened, but only a small quantity of blood escapes on the whole, and that merely from the larger vessels. Acini scarcely perceptible, but on closer examination they are seen to be surrounded by a faint light grey ring.

78. Gall-bladder filled with a somewhat ropy, but otherwise clear, dark grey gall.

79. Inferior vena cava moderately distended with blood, for the most part fluid.

This case is a truly remarkable example of the tolerance exhibited by the brain towards injuries of the gravest character. It seems almost miraculous that any one could possibly live twelve hours with a gunshot wound extending from the left frontal region and the apex of the anterior lobe to the external aspect of the middle lobe on the right side (just above the parietal eminence), completely traversing, therefore, in an oblique direction, the right hemisphere of the brain, and also the extra-ventricular part of the corpus striatum. It is only to be accounted for by the smallness of the projectile, and to some extent, also, perhaps, by the slight force which it possessed. The projectile must have been about the size of a pea (five millimetres in diameter), judging from an unused bullet which was found upon the man. The width of the track of the wound in the brain (anteriorly twelve, posteriorly eighteen millimetres) is therefore quite out of proportion to the width of the aperture of entrance in the integument (three millimetres), and in the bones (six to eight millimetres), and also to the projectile. There can, therefore, be no doubt that the track of the wound in the brain was originally much narrower, and that the width which it finally attained was due to the increasing effusion of blood. The symptoms, therefore, of compression of the brain gradually developed as the extravasation increased.

That the force of the projectile was very slight is evident from the fact that not only was there no injury to the bone in the neighbourhood of its place of exit from the brain, but there was even no laceration of the dura mater. The force of the bullet, primarily weak, was still further reduced by its having traversed two layers of bones in its passage through the left frontal sinus; and, on the other hand, the fact that both blood and cerebral matter found an exit through the frontal sinus may well have assisted to retard the development of the symptoms of compression. It thus happened that death resulted not from the brain primarily, but (in a medico-legal sense) from the lung, and, strictly speaking, was due to suffocation. Just as so often occurs in injuries to the head caused by contusion, a fatal œdema of the lung became developed in consequence of the pressure of the extravasated blood upon the medulla oblongata. How greatly the respiration was affected is shown by the interstitial emphysema, which was more extensive in this case than I have ever seen it in the asphyxia of cholera. We should notice, by the way, a combination in itself so very unusual, for, according to current notions, œdema and interstitial emphysema ought strictly to exclude each other.

The widespread indications that the digestive process had not yet terminated, allow us to suppose that the suicide had taken his last meal shortly before the commission of the deed. In addition to this, there are various appearances, which I have grouped together in the summary, indicating the occurrence, in a very early stage, of numerous natural deficiencies, which amply warrants us in drawing conclusions as to the psychological development. The chlorotic condition of the aorta, which may well be connected with the endocarditis mitralis, certainly not very common in so young a man; the obliquity of the cranium, together with the want of symmetry and somewhat defective formation of the brain, are all of them appearances well worthy of observation.

If there were any doubt about the case, and had it been made the subject of legal inquiry, we might summarise our opinions provisionally as follows:—

(1.) That death resulted from œdema of the lung, consequent upon a gunshot wound of the brain.

(2.) That there is no evidence from the autopsy to contradict the assumption that the deceased came to his death by his own hand.

## Case III.

A person known (suicide). Gunshot wound of the chest. Death occurring in twelve days. Double pleuritis, pericarditis and myocarditis, phlegmonous mediastinitis, exudative peritonitis.

F. K., a tradesman's assistant, twenty years of age, shot himself in the chest, on the afternoon of November 8, with a revolver held at a distance of six inches from his breast, he at the time having nothing on but his shirt. He was immediately brought to the Charité. The aperture of the wound is close to the left nipple, and measures eight millimetres in diameter; it is filled up with clots of blood, and the parts around are emphysematous. The patient complains of difficulty of breathing, and pain all over the left side, where there is also dulness on percussion over the posterior and inferior parts of the chest, extending to the angle of the scapula, with bronchial expiration. The bullet was found in the back above the eighth rib, at a distance of four fingers' breadth from the vertebral column on the left side, and was removed on the following day. It was conical in shape, eleven millimetres long, and seven millimetres in diameter at its base, quite flattened on one side, especially towards its apex. The opinion of the physicians in charge of the case was, that the bullet had passed in the soft parts outside the chest, and had been stopped by the rib.

On the third day, pain came on quite suddenly in the region of the left colon, with great soreness. Manifest improvement on the subsequent days, but great mental excitement and restlessness. The aperture of the bullet's entrance closes, but inflammation and swelling occur round the opening which has been made in the back. The symptoms of inflammation in the left breast gradually diminish. Bowels somewhat confined. On the eighth day a red-coloured serum commences to escape from the wound in the back, and flows more freely during expiration. At the same time there are evident symptoms of pleuritis on the right side, and also of pericarditis. Increased fever and difficulty of respiration. On the eleventh day a puncture was made in the left side of the thorax, in the fifth intercostal space, in the anterior axillary line, and 900 cubic centimetres of a dirty brownish-red serum evacuated. The respiration then for a short time became easier, but very soon after all the serious symptoms became much aggravated, and the patient died on the thirteenth day.

Post-mortem examination (lasting three hours):

### A. *External Examination.*

1. The body is that of a man of about twenty years of age; the height is 1·68 metre; bony conformation slight; adipose tissue in small quantity; muscles moderately developed.

2. Colour generally pale, faintly yellow; lower part of abdomen greenish. The posterior parts of the body, the head, and trunk generally, and also the extremities, covered with large pale bluish-red spots, interrupted by white

patches where exposed to pressure. The intensity of the colour of these spots can be only slightly diminished by pressure. On an incision being made, numerous small veins filled with blood can be seen extending from the skin into the substance of the muscles. Fluid blood escapes from these, but there is nowhere any blood extravasated in the tissue.

3. Slight cadaveric odour; rigor mortis in the extremities.

4. Eyelids half closed; eyeballs tense; cornea transparent.

5. No foreign body in nose or auditory meatus.

6. Lips open; teeth separated—the latter, in the upper jaw, very irregular. The tongue lying behind the teeth, and pale: the teeth of a brownish hue. No foreign body in the mouth.

7. Nothing abnormal to be found about the neck.

8. On the right side of the breast a line of four small brownish-red crusts, one after the other, but separated by intervals of various lengths. The first of these is over the fifth rib, the second over the sixth, the third and fourth are over the seventh. The upper one begins a finger's breadth below the right nipple, and at about the same distance on its inner side. The whole line is ten centimetres in length; its direction is somewhat obliquely downwards and outwards. On cutting into these spots there is neither deposit, tumefaction, nor redness. On cutting through them there are no spots of blood, but only desiccated patches, extending in the highest crust through the whole thickness of the corium, in the others only through its most superficial layers. There is a faint, quite superficial, crescentic, red spot rather more than a thumb's breadth on the outer side of the right nipple. This, on being cut through, is found to involve only the outermost layers of the corium. There are also a few more brown

marks on the external aspect of the lower part of the thorax on the right side.

9. On the left side, two millimetres above the nipple, but within the areola, a small round spot about 1·5 millimetre in diameter, somewhat depressed, of a dirty brownish colour, and covered with a dry pellicle. When this is cut into, a somewhat hard cord, traversed by numerous small vessels filled with blood, and showing minute spots of blood, is found to extend obliquely outwards and backwards through the substance of the gland into the subcutaneous fat. No canal can be discovered, but in a direction outwards and downwards there are some scattered spots, slightly moist, and blackish-red in colour, both in the subcutaneous adipose tissue and in the pectoral muscles, extending down to the ribs, in a circumference of about seven centimetres. They are most strongly marked in the direction towards the axilla, where a few of these sanguineous infiltrations extend to the lymphatic glands. These latter are enlarged, hard, bluish-red externally. On being cut through they are found to be very moist, and the whole of their cortical layers of a dark bluish-red colour.

10. Posteriorly, on the left side of the chest, at a distance of two fingers' breadth from the middle line, on the tubercle of the ninth rib, the skin is separated from the subjacent parts, and exhibits a wound with sharply defined edges. The wound is four centimetres long and two centimetres and a half wide, taking almost the exact direction of the rib—viz., from within and above, outwards and downwards. It is covered with slightly dull greyish-red serum, and looks quite clean where this latter has been removed; it penetrates the soft parts in a terrace-like form to a depth of eight millimetres, and terminates in the muscles. The base of the wound is pale and smooth in the external portion; internally it is covered with a soft, velvety, very red film, which contrasts distinctly with the neighbouring parts. Only in an upward direction is there

any bloody infiltration of the muscular tissue even on incision being made into the parts around.

11. On cutting more deeply into the muscular layers lying externally, we come into a shallow cavity which communicates by a narrow opening with the base of the wound above described; it measures four centimetres and a half transversely, and three centimetres perpendicularly; its outer surface is tolerably smooth, and, like the base of the external wound, covered with a similar soft, velvety, red membrane. On opening this cavity, the body being placed on its side, air emerges from beneath with an audible sound, and a small round opening not quite two millimetres in diameter is found on the upper part of the base of the cavity. This penetrates deeply the intercostal space between the eighth and ninth ribs, but on introducing a fine probe it cannot be passed directly into the thoracic cavity. The spiral direction of the track of the wound makes it difficult to pass the probe deeply.

12. The two spots described in Nos. 9 and 10 are now connected by means of a free incision carried transversely round the thorax. The muscular septa in the neighbourhood only of the first spot are found to be distended with dark-red serum, but otherwise there is no trace of any connection between the two wounds.

13. Four fingers' breadth external to and below the left nipple there is a roundish opening, scarcely one millimetre in diameter; the borders of this wound are sharp and rather dry. On incisions being made in various directions, dark-red bloody discolorations are found in the corium below this opening, and these are continuous with those described under No. 9. (This is the aperture of the puncture as stated by the assistant-physician in charge, Dr. N.) No distinct canal can be traced inwards from this opening. On the other hand, on cutting somewhat more deeply into the intercostal muscle, serum and bubbles of

air escape from beneath, and there is a softish, reddish streak to be seen traversing the tissues.

14. Nothing abnormal about the external organs of generation.

15. Anus closed; some faecal matter round about it.

16. No traces of any other external injury.

### B. *Internal Examination.—a. Thorax and Abdomen.*

17. An incision is carried from the chin to the symphysis pubis, dividing the integuments of the neck and thorax, and opening the abdominal cavity. Adipose layer slight; muscles of a dull-red colour.

18. The omentum found to be connected by adhesions, which are easily separable, with the anterior part of the abdominal wall and the right border of the liver. This latter organ is somewhat deeply placed, and completely covered by a delicate false membrane, which can be easily stripped off: on the left side it is dry and translucent; on the right side more greasy-looking, dull, and yellowish in colour. The omentum is of a deep-red colour, its veins being particularly full (this most marked on the right side); in the neighbourhood of the gall-bladder it is covered with opaque, yellow false membrane that cannot be stripped off, and this extends as far as the lumbar region.

19. The intestines distended with gas, covered in many places with fine, very superficial, red, vascular networks—generally, however, pale; the viscera of the pelvis only dense bluish-red, with numerous large prominent veins.

20. The pelvis contains about a tablespoonful of slimy, yellowish-red, opaque serum.

### (1.) *The Thorax.*

21. During the time that has elapsed since the examination of the wound described in No. 10, a quantity amount-

ing to eighteen cubic centimetres of thin, pale-reddish, turbid serum, has escaped from this spot into a vessel placed to receive it.

22. On removing the integuments from the thorax, the tissues are found to be considerably infiltrated with blood, on the left side, in the fourth and fifth intercostal spaces: in the first of these at a distance of three, and in the second at a distance of two fingers' breadth from the sternum.

23. On cutting into the wall of the thorax on the right side, fluid escapes. This is immediately collected from the pleural sac. It is found to amount to 800 cubic centimetres, is thin, relatively only slightly turbid, and of a yellowish-red colour. It contains numerous large very loose flakes, yellowish-white in colour. The surface of the pleura on this side is everywhere covered with somewhat soft dirty-yellowish deposit, which can be stripped off.

24. The sternum being removed, the whole of the mediastinum is found to be tough and difficult to cut, many of its smaller vessels filled with blood, and the tissue throughout of a gelatinous appearance and of a dull brownish-yellow colour.

25. On the left side, the anterior portion of the lung is agglutinated to the wall of the thorax for a length of eight centimetres. After it has been separated we come to a space filled with fluid. The fluid is ladled out: it measures 900 cubic centimetres, is somewhat thick, but flows freely, is of a palish-red colour, has a faint odour, and contains a few flakes. This cavity is the pleural sac, the walls of which, except where they are agglutinated, are covered with thick, dirty reddish-yellow, closely adherent deposits, with red infiltration in some places. The upper and lower lobes are agglutinated together below. There are also adhesions which can be easily broken up between the thoracic wall and the lower part of the upper, and the anterior and lower part of the lower, lobe. These adhe-

sions extend over a surface as large as a child's hand. In front, between the pericardium and lungs, is a closed space, containing large shreds of gelatinous coagula. This cavity is found to be an incapsulated part of the pleural sac.

26. The pericardium much thickened externally. Internally, extensive deposit of rough, stiff, elastic membrane, both on the parietal and visceral layer. The cavity contains about forty cubic centimetres of pale-reddish serum, mixed with yellowish flakes. The firm deposit is most abundant on the anterior portion of the parietal layer; and, corresponding to this, the heart is covered anteriorly by similar false membrane.

27. The heart itself is somewhat larger than the closed fist of the man. It is rigid, its surface slightly arched, comparatively pale in colour. The right auricle contains about ninety cubic centimetres of dark-red coagulated blood. The right ventricle contains a very small quantity of fluid blood, but a few large, gelatinous, buffy masses. The left auricle contains scarcely two tablespoonfuls of dark blood, very slightly coagulated. The left ventricle is almost empty.

28. The heart is then removed. The arterial valves close. On being opened, a marked red infiltration throughout the lining membrane. The muscular tissue firm; on the right side greyish-red; eighteen millimetres thick. On the posterior wall it is closely marked to a depth of eight millimetres with very extraordinary yellow spots and stripes. These spots being immediately subjected to microscopical examination show the primitive muscular fasciculi to be without cross-markings and filled with coarse fat-granules. No other abnormal appearances.

29. A very large quantity of dark, partly buffy coagula escapes from the large vessels of the thorax.

30. The left lung is rather flat, and contains but little

air. Its serous covering on the upper and anterior parts is thickened, opaque, here and there yellowish; on the inferior and posterior parts of a dull-red colour, softer and more lubricous, dotted over in several places with soft, grey, roundish granulations. In three places the covering of the lung is relatively smooth, and shows scarcely any deposit. These places are circumscribed by tolerably sharp edges, with salient and receding angles. There are similar places corresponding to these on the wall of the chest. The first of these spots is close to the anterior border of the upper lobe, near the agglutination described in No. 25. The second spot is on the lower tongue of the upper lobe. The surface of the lung is here induplicated in two directions, meeting in an angle, and taking a course towards the spot immediately to be described. The third spot is on the lower and anterior aspect of the lower lobe, and here in a line, one below the other, we find (*a*) on the surface turned to the cleft between the upper and lower lobes, one centimetre from the border, a roundish depression of a reddish colour, three millimetres in diameter, exhibiting, on incision, a perforation of the pleural investment: (*b*) two round spots close to one another, two and a half to three millimetres in diameter; one of which is upon, the other close in front of, the border. These being cut through, are found to be yellowish-white channels in the pleural membrane and the adjacent pulmonary tissue. The latter is on this spot somewhat firmer, and of a deep-red colour to a depth of eight millimetres. On section the tissue in the upper lobe is found to contain very little air, is of a red colour throughout; but it is only from the larger vessels that any blood escapes. The lower lobe contains still less air, and is moderately red: dark thick blood escapes from the vessels.

31. The right lung is covered throughout its whole extent with firmly adherent but separable deposit: on the upper and middle lobes the pleural covering is whitish and thickened. On section the tissue is found to contain but

little air, and is somewhat grey in colour; this is the case also in the lower lobe.

32. On the inner aspect of the thoracic wall on the left side, exactly upon the eighth rib, at a distance of four fingers' breadth externally from the vertebral column, there is a solution of continuity, twelve millimetres long and five millimetres wide, of a somewhat long oval form, the long diameter being parallel to the axis of the rib, the borders gradually sloping off, and of a yellowish colour. In the base of this wound the bone lies exposed. In order to examine the parts more closely, this rib and the ninth are removed together, and it is now seen that, at the spot corresponding to the external wound, the inner surface of the eighth rib, for a length of fourteen and a breadth of ten millimetres, is quite laid bare, and the soft parts stripped off. At this spot there are two small linear fragments of lead, the larger three, the smaller one and a half millimetres long, wedged into the compact tissue of the bone. Round the denuded portion of the rib the tissue is raised up like a wall, thickened and much reddened. Beyond this wound, anteriorly, and on the same rib, a triangular, greyish-yellow spot is found on the costal pleura, which exactly corresponds with a similar triangular spot on the inferior lobe of the lung, immediately below the smooth spot described in No. 30, and in the direction of the appearances detailed under (*a*) and (*b*) in the same paragraph. A continuous canal connects the denuded portion of bone with the cavity mentioned in No. 11.

33. In the anterior lateral portion of the circumference of the left pleural cavity, in the intercostal space between the fourth and fifth ribs, three centimetres from the attachment of the cartilages, is a deepened cleft, placed transversely to the course of the third rib, seven millimetres long, and rather more than three millimetres wide: running somewhat obliquely from above and within, downwards and outwards, ending above the border of the fifth

rib, and separating the fasciæ superficially. The floor of this cleft is tolerably smooth, slightly scaly. The borders of the cleft are sharp, neither thickened nor reddened; in its base several small, angular, blackish fragments of lead, are contained in the tissue. This spot corresponds to an area of the pulmonary pleura, free from deposit, and which had previously been adherent (No. 25).

34. Lower down in the intercostal space, between the fifth and sixth ribs, and almost exactly in the middle, there is a somewhat long cleft, with tolerably straight borders; it is scarcely two millimetres long, and its lateral edges are close together. It leads directly externally into a small canal through the muscles. Its position corresponds to the external wound described under No. 13, but there is no open passage from one to the other.

35. The veins of the neck are tumid, and contain thick blood; arteries and nerves normal.

36. The œsophagus contains a yellowish-grey fluid, and numerous fragments of food. Mucous membrane pale. Palate much reddened, with very prominent venous networks; follicles of the tongue slightly swollen.

37. The larynx contains a few similar yellowish-green fragments of food. Below, a little frothy liquid in the air-tubes. Mucous membrane somewhat thick: that of the air-tubes very red, owing to numerous vascular networks, which are distinctly visible.

38. No change in the walls of the aorta: only a little thick blood in its descending portion.

### (2.) *The Abdomen.*

39. The spleen adherent on its upper aspect, 12½ centimetres long, 7½ centimetres broad, 3·6 centimetres thick, firm on section, and pale: the pulp rather greyish-red and uneven, containing much blood and slightly indurated.

[illegible]

[illegible] only in a part which is covered with [illegible] yellowish-white membrane. [illegible]

10. Left kidney 12 centimetres long, [illegible] centimetres broad, 3·2 centimetres thick. The [illegible] [illegible] [illegible] On section [illegible] [illegible] which appear [illegible]. The [illegible] [illegible] on the cut [illegible].

11. The left suprarenal capsule [illegible] [illegible] and [illegible] [illegible].

12. Right kidney 11 centimetres long, [illegible] broad, 2 [illegible] centimetres thick. The [illegible] [illegible] through the other side. In other respects [illegible] same appearance [illegible] as the [illegible] on the other side.

13. Urinary bladder strongly contracted, [illegible] tablespoonful of dark yellowish brown urine. Its [illegible] mucous membrane [illegible] also the prostate [illegible] [illegible].

14. Testes. Both [illegible] and [illegible] [illegible] in every respect normal.

15. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

16. [illegible] [illegible] [illegible] [illegible].

17. [illegible] twenty-five centimetres [illegible] from head to heel [illegible].

6,

thick; the whole of its external surface covered with yellowish-white false membrane. On incision, the large vessels only found filled with blood. The tissue pretty uniformly brownish-grey, brittle, somewhat dull looking. The acini large, externally yellowish, internally greyish-red. Gall-bladder slightly coloured; bile greyish-brown, with yellow flakes.

48. Pancreas somewhat flabby; its posterior portion infiltrated with blood.

49. The mesenteric glands somewhat enlarged; their cortical portions somewhat white. But little fat about the mesentery.

50. The small intestine contains a large quantity of pasty, bilious matter; in the lower portion the contents are faeculent and foul-smelling. The mucous membrane is rather thick; in the jejunum reddened only in a few spots; a few turgid veins in other places. The only change in the glands is a very slight swelling of the solitary follicles in the lower part of the ileum.

51. The large intestine contains soft faeces; mucous membrane rather thick: some difficulty in removing the adherent faeces; nothing abnormal.

### *b. The Cranium.*

52. The soft parts cut through according to the directions, and reflected backwards and forwards: nothing abnormal.

53. The skull of a somewhat long oval form, much reddened posteriorly, and presenting a pitted depression on the frontal bone, just in front of the coronal suture, and to the right of the mesial line. On section, diploe scanty but red. Bones of skull four millimetres thick. Internal surface somewhat irregular in consequence of various depressions in the middle part of the frontal bone and

along the sagittal suture; these are apparently due to elevations of the pia mater.

54. The dura mater translucent, thickened, and copiously supplied with blood in the middle and anterior portion. The longitudinal sinus rather large, filled with buffy coagula. Inner surface of the dura mater on both sides smooth, exhibiting in places networks of distended vessels, but no abnormal deposit.

55. The surface of the cerebral hemispheres symmetrical in shape. The convolutions rather large. Veins very large, much distended with dark blood, particularly at the back of the head.

56. Pia mater everywhere translucent, exhibiting large wart-like excrescences along the median longitudinal fissure and under the frontal bone.

57. Scarcely any fluid in the lateral ventricles. Posterior cornua obliterated. Choroid plexus and vessels of the velum of a dark-red colour.

58. On section the cerebral hemispheres found to be very moist, and the veins much distended. From these latter large drops of blood exude all over the cut surface. Grey substance shining and of a dark reddish tinge.

59. The grey substance of the large ganglia reddened; the tissue very moist throughout. Corpora quadrigemina pale.

60. Fourth ventricle empty. Cortical portion of cerebellum uniformly reddened; veins of medullary substance distended.

61. The arteries at the base of the brain regular in their course, filled with dark blood. In the pia mater of this part nothing abnormal.

62. The grey substance of the pons Varolii and medulla oblongata slightly reddened.

63. The sinuses at the base of the skull filled with dark

thick blood. The dura mater thin and delicate. Condition of the bones normal.

There is much that is worthy of remark about this case. Apart from the fact that the extensive peritonitis did not occur as a clinical symptom (we must now regard as such the pain in the region of the left colon, which was noticed on the third day of the disease, but which afterwards quite subsided), the rapidity with which death occurred must obviously be explained by the pericarditis and the resulting myocarditis. Some time ago (in my *Archiv*, 1858, vol. xiii. page 266) I reported several cases of malignant pericarditis, in which I demonstrated acute fatty metamorphosis of the muscular tissue, and showed that the morbid process advanced from without to within. I have several times since observed this very dangerous complication, of which the case before us is another and a very instructive example.

The peritonitis, and also the pericarditis, and the pleural inflammation on the right side, have no immediate connection with the wound caused by the bullet. The probability is that all of these are the result of the phlegmonous mediastinitis, which in this case quite takes the form of a malignant erysipelas. The occurrence, however, of this mediastinitis is not a little extraordinary, for the bullet did not immediately injure the mediastinum; and, moreover, the anterior portion of the track of the bullet showed no indications of mischief, for it was completely closed by the first intention. There is, therefore, nothing else but to assume that all these morbid processes have extended themselves from the posterior part of the track, which was certainly in an unhealthy condition, and which was converted into a perforating wound when the bullet was excised. It is, therefore, very extraordinary that when the examination was made there was no disagreeable odour about the opening in the back.

Notwithstanding this, however, a propagation of infectious matter from this quarter is indicated by the extensively diseased appearance of the left pulmonary pleura, and the alterations so unusually great for so comparatively short a period as twelve days. The pleura was so thickened, dull, and wrinkled, and so dotted over posteriorly with real sprouting granulations, and in large area almost trachomatous, as to present an appearance such as is only met with in very malignant forms of inflammation. Those portions of the pleura primarily agglutinated appeared, after separation, both on the lung and on the wall of the chest, so smooth and delicate that they looked quite normal when contrasted with what has just been described.

The autopsy has not confirmed the supposition that this was a case in which the bullet, in consequence of the retracted position of the left side of the chest, took a curved direction through the external soft parts from the place of entrance near the nipple, until it was stopped posteriorly by the eighth rib. Certainly, it appeared at first as if the sanguineous infiltrations (No. 9) extending to the axilla corresponded with the course taken by the bullet. But the further examination showed that the bullet had taken an entirely opposite direction, and that the infiltrations were caused only by the loose cellular tissue being filled with blood in the direction of the lymph-current. Even the axillary glands were so infiltrated with blood as to prove distinctly that their appearance was due to absorption. I draw particular attention to this, inasmuch as I am well aware that in medico-legal practice due regard is not paid during life to this form of propagation of sanguineous infiltrations, so very important, and yet so often misleading, owing to the great possibility of a false interpretation.

The shot has entered just above the left nipple, and taken an oblique direction outwards, downwards, and backwards; it has left the wall of the chest, first of all, in the fourth intercostal space, and then entered the pleural cavity; it has then grazed the lung, but only a small portion of it—viz., the surface of the left lower lobe turned towards the cleft between the two lobes; it has then passed over the internal surface of the eighth rib, at a distance of four fingers' breadth from the vertebral column, and close to this spot perforated the eighth intercostal space. Here it remained lying in the soft parts under the skin of the back until its early removal.

Strange to say, at the end of the channel of entrance, just where it passes obliquely over the upper border of the fifth rib, several small pieces of lead, obviously portions of the bullet, were found covered up in the soft parts. At the first glance, they might be compared with the fragments of lead embedded in the bone, at the posterior part of the circumference of the thorax, where the rib has been laid bare by the bullet. However, a closer examination proves that their origin is different. The latter were obviously splintered off when the bullet struck against the rib, and they correspond probably to the small scratches found on the smooth compressed surface of the much-flattened bullet. The former, on the other hand—those which are closed up in the anterior wound,—could not have been splintered off by the rib, for its border, although very close to the bullet's course, has not been touched by it. These must, therefore, have been stripped off previously, perhaps in the grooved barrel of the revolver, and driven into the wound when the shot was fired.

The medico-legal conclusions in this case are as follows:—

1. That death was caused by a series of violent inflammatory attacks in the thoracic and abdominal cavities, inflammation of the heart being the principal factor.

2. That these inflammatory attacks were the result of a gunshot wound of the thorax.

3. That there is nothing to contradict the assumption that the fatal shot was fired by the deceased himself.

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